Aero Vodochody L-39

Airworthiness Certification

AIR-230 Airworthiness Certification Branch
Federal Aviation Administration
Washington, D.C.
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Introduction – Aero Vodochody L-39 Airworthiness Certification

This document provides information to assist in the airworthiness certification and safe civil operation of a L-39 aircraft.

Attachment 1 provides a general overview of this document. Attachment 2 contains background information on the L-39 aircraft. Attachment 3 lists historic airworthiness issues with the L-39 for consideration in the certification, operation, and maintenance of these aircraft. The list is not exhaustive, but includes our current understanding of risks that should be assessed during in the certification, operation, and maintenance of these aircraft. Concerns regarding particular issues may be mitigated in various ways. Some may be mitigated via the aircraft maintenance manual(s) or the aircraft inspection program. Others may be mitigated via operating procedures i.e., SOPs) and limitations, aircraft flight manual changes, or logbook entries

Not all issues in attachment 3 may apply to a particular aircraft given variations in aircraft configuration, condition, operating environment, or other factors. Similarly, circumstances with an aircraft may raise other issues not addressed by attachment 2 that require mitigation. Attachment 4 includes additional resources and references. Attachment 5 provides some relevant L-39 accident and incident data.

Attachment 1 – Overview of this Document

Purpose

This document is to provide all those involved in the certification, operation, and maintenance of the L-39 aircraft with safety information and guidance to help assess and mitigate safety hazards for the aircraft. The existing certification procedures in FAA Order 8130.2, Airworthiness Certification of Aircraft and Related Products, do not account for many of the known safety concerns and risk factors associated with many high-performance former military aircraft. These safety concerns and risk factors associated with many high performance former military aircraft include—

- Lack of consideration of inherent and known design failures;
- Several single-point failures;
- Lack of consideration for operational experience, including accident data and trends;
- Operations outside the scope of the civil airworthiness certificate;
- Insufficient flight test requirements;
- Unsafe and untested modifications;
- Operations over populated areas (the safety of the non-participating public has not been properly addressed in many cases);
- Operations from unsuitable airports (i.e., short runways, Part 139 (commercial) airports);
- High-risk passenger carrying activities taking place;
- Ejection seat safety and operations not adequately addressed;
- Weak maintenance practices to address low reliability of aircraft systems and engines;
- Insufficient inspection schedules and procedures;
- Limited pilot qualifications, proficiency, and currency;
- Weapon-capable aircraft not being properly demilitarized, resulting in unsafe conditions;
- Accidents and serious incidents not being reported; and
- Inadequate accident investigation data.

Research of L-39 Safety Data

The aircraft, relevant processes, and safety data are thoroughly researched and assessed. This includes—

- Aviation Safety (AVS) Safety Management System (SMS) policy and guidance;
- Historical military accident/incident data and operational history;
- Civil accident data;
- Safety risk factors;
- Interested parties and stakeholders (participating public, non-participating public, associations, service providers, air show performers, flying museums, government service providers, airport owners and operators, many FAA lines of business, and other U.S. Government entities);
- Manufacturing and maintenance implications; and
- Design features of the aircraft.

This Document

The document is a compilation of known safety issues and risk factors identified from the above research that are relevant to civil operations. This document is organized into four major sections:

- General airworthiness issues (grey section),
- Maintenance (yellow section),
- Operations (green section), and
- Standard operating procedures and best practices (blue section).

This document also provides background information on the aircraft and an extensive listing of resources and references.

How to Use the Document

This document was originally drafted as job aids intended to assist FAA field office personnel and operators in the airworthiness certification of these aircraft. As such, some of the phrasing implies guidance to FAA certification personnel. The job aids were intended to be used during the airworthiness certification process to help identify any issues that may hinder the safe certification, maintenance, or operation of the aircraft. The person performing the certification and the applicant would to discuss the items in the job aid, inspect documents/records/aircraft, and mitigate any issues.

This information would be used to draft appropriate operating limitations, update the aircraft inspection program, and assist in the formulation of adequate operating procedures. There are also references to requesting information from, or providing information to the person applying for an airworthiness certificate. We are releasing this document as drafted, with no further updates and revisions, for the sole purpose of communicating safety information to those involved in the certification, operation, and maintenance of these aircraft. The identified safety issues and recommended mitigation strategies are clear and can be considered as part of the certification, operation, and maintenance of the air aircraft.

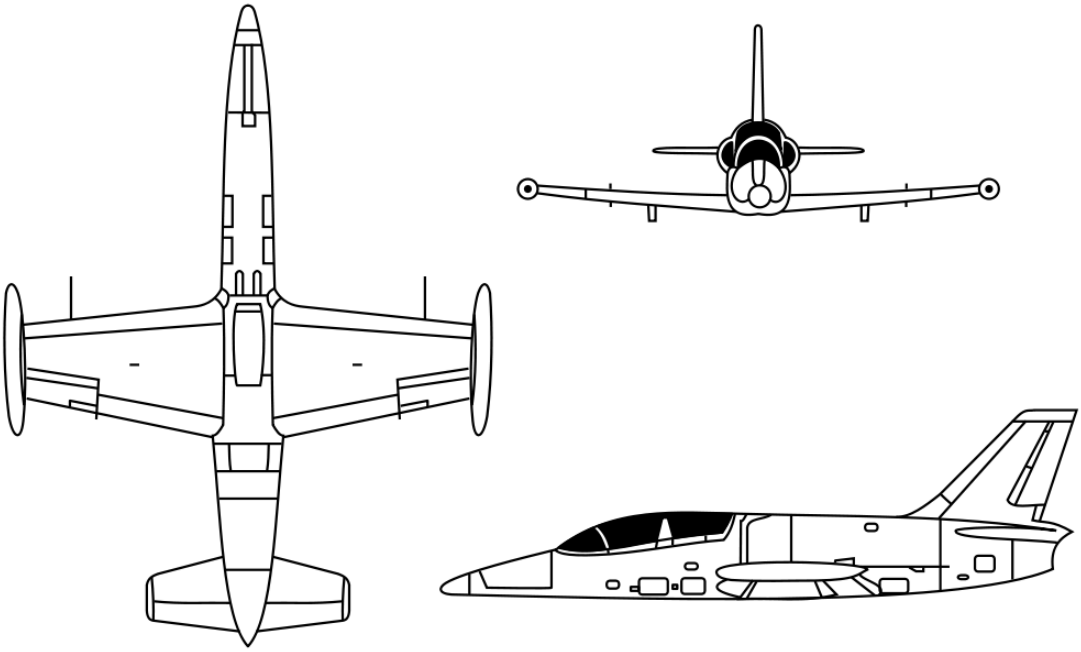
Attachment 2 – Background Information on the L-39

The Aero Vodochody L-39 Albatros is a late 1960s (first flown in 1969) high-performance jet trainer aircraft developed in Czechoslovakia during the Cold War. It was the first of the second-generation jet trainers, and the first turbofan-powered trainer produced. The design is still produced and more than 2,800 L-39s have served with over 30 air forces around the world. The aircraft remains in operational service with many air forces around the World, including several NATO countries, including Hungary, Czech Republic, Bulgaria, Lithuania, Slovakia and Estonia.

Several variations of the L-39 exist, including the L-39C, L-39 ZO, L-39 ZA, L-59, L-139, and the L-159. The L-159, first flown in 1997, is the current version of the aircraft being manufactured. It differs from its predecessors in that it incorporates modern avionics with a U.S. engine. The L-159 is not a surplus aircraft like many L-39s in civil use today, and it is not operated as a civil aircraft in the U.S. The
L-39 configurations vary in many ways, including ejection seat systems, structures, armaments, and gross weight. The first civil L-39 flew in the U.S. in 1992, and today, there are about 250 in the FAA Registry. It is estimated that 130 are operational. The L-39 is, by far, the most numerous civil former military jet aircraft operating in the U.S. The aircraft is also operating as a civil aircraft in other countries, including Australia, Estonia, Russia, United Kingdom, and South Africa.

Data from L-39 military operations identifies several mechanical and operational safety issues. Additionally, the safety record of the aircraft in U.S. civil operations is relevant. Between 1998 and 2012, there were 19 civil L-39 accidents in the U.S. Of these, 14 were fatal, and 6 involved passenger fatalities, in addition to the pilot in command (PIC).

None of the attempted L-39 ejections were successful. The general aviation accident rate per 100,000 hours (2000-2009) for non-commercial fixed-wing is 6.60. In contrast, the L-39 accident rate in U.S. civil operations (1998-2012) is estimated at 23 accidents per 100,000 hours. For comparison purposes, the safety record of comparable basic jet trainers in USAF service is 1.02 per 100,000 for the Cessna T-37 (1956-2010) and 0.44 per 100,000 hours for the new Raytheon T-6 (2000-2011). These data strongly supports the need for the airworthiness review prescribed by this document.



Source: Above, U.S. Arm. Below, FAA.

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
L-39 Preliminary and General Airworthiness Inspection Issues			
1.	Aircraft Familiarization	Become familiar with the aircraft before initiating the certification process. One of the first steps in any aircraft certification is to be familiarized with the aircraft in question, in this case the L-39. Such knowledge, including technical details are essential in establishing a baseline as the certification process moves forward.	
2.	Preliminary Assessment	In some cases, a preliminary assessment of the aircraft may be conducted to ascertain condition and general airworthiness.	
3.	Airframe and Engine Data	Applicants should provide the following: Airframe: import country, N-Number, manufacture year and serial number, airframe time, and airframe cycles. Engine: manufacture date and serial number, overhaul data and location, serial number, engine time and cycles and date(s). Other areas of interest include: fire bottle cartridge data; SAPHIR-V Auxiliary Power Unit (APU) overhaul/manufacture date, serial number, time, cycles/date; A/C turbo overhaul/manufacture date, serial number, time, cycles/date; last flight; number of flights in the last 6 months; parachute manufacture and repack dates for both front and rear seat parachutes; and pyrotechnic device data.	
4.	FAA Records Review	Review the existing FAA airworthiness and registration files (EDRS) and search PTRS (Program Tracking and Reporting Subsystem) for safety issue(s) and incidents.	
5.	Use FAA Form 8100-1.	Use FAA Form 8100-1 to document the airworthiness inspection. The use of this form facilitates the listing of relevant items to be considered, their nomenclature, any reference (i.e., NAVAIR manual, FAA Order 81302., regulations) revision, SAT or UNSAT notes, and comments. Items to be listed include but are not limited to: 1. 8130.-6 2. §21.193 3. 8050-1A 4. § 45, 45.11(a) 5. 81130.2G, Para 4002ª (7) (10), 4002b (5), 4002b (6), 4002b (8), 4111c, 4112ª (2) 6. §91.205 7. §91.417(a)(2)(i) Airframe Records and Total Time, Overhaul 8. §91.411/91.413 Altimeter, X-ponder, Altitude Reporting, Static System Test	
6.	Functionality Check	As part of the airworthiness certification, ask the applicant to prepare the aircraft for flight including all pre-flight tasks, start-up, run-up, and taxi.	

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7.	Adequate Manuals and Related Documentation	To safely operate an L-39, the owner/operator must have a complete list of the applicable L-39 manuals such as flight manuals, inspections and maintenance (manufacturer or NATO) manuals. Examples include: ➢ *Flight Manual 1T-L39C-1.* ➢ *Pilot Training Manual(s): Technical Training and Flight Training/Operation* ➢ *Checklists and Procedures: Pre-Flight and Post-Flight Inspection, Pilot's Checklist, Check List for Ground Crew, Failed Landing, W&B, Aircraft Weighing Procedures, Briefing for Passengers, Fuel Calculations, Flight Situations, and General Description.* ➢ *Tech Description L-39.* ➢ *APU Sapphire 5 Manual. Maintenance Instruction L-39.* ➢ *Job Cards for Aircraft Inspection.* ➢ *Job Cards for AI-25 Engine.* ➢ *Illustrated Parts Catalogue (IPC).* ➢ *Album of Joints and Repair Tolerances.* ➢ *Tech Description L-39 Manuals:* • *Instructions for the Pilot* • *Airframe and Engine Installation* • *Electro Equipment and Instruments and* • *Radio Equipment* • *Engine AI-25 TL* • *Armament and Rescue System* ➢ *Inspection Schedules and Replacement Times, i.e., NATO "-6-1" Technical Order.* Note: The use of and reference to NATO manuals are made in this document because they represent an equivalent to the acceptable USAF and hence to the FAA.	
8.	Limiting Duration of Certificate	As provided in FAA Order 8130.2, the duration of certificates may be restricted if the FAA finds cause. It would be possible to permit operations for a period of time to allow the implementation of a corrective action or changes in limitations.	
9.	L-39 Aircraft Series	Identify the series of the L-39 aircraft in question, i.e., Series 18 or 19. There are many differences among between the different series of L-39s, many in terms of systems, i.e., hydraulic accumulators.	
10.	Applicant/Operator Capabilities	Review the applicant's/operator's capabilities, the general condition of working/storage areas, the availability of spare parts, and equipment.	

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11.	Scope and Qualifications for Restoration, Repairs or Maintenance	Become familiar with the scope of the L-39 restoration/repairs/maintenance conducted by or for the applicant.	
12.	Operational Risk Management (ORM)	Recommend that an ORM-like approach be implemented by the L-39 owner/operator. ORM employs a five-step process: (1) Identify hazards, (2) Assess hazards, (3) Make risk decisions, (4) Implement controls and (5) Supervise.	
13.	Multiple Certificates and Public Air Operations, i.e., Department of Defense (DoD) contracts. Also see *Military Operations* below.	In those cases involving multiple certificates, such as Exhibition and R&D, the applicant must submit information describing how the aircraft configuration is changed from one to the other. This is important because some R&D activities may involve equipment that must be removed to revert back to the Exhibition configuration. Moreover, the procedures should provide for any additional requirement(s), such as additional inspections, to address situations such as high-G maneuvering which could have an impact on the aircraft and/or its operating limitations. Similarly, removing equipment that could be considered part of a weapon system may be required (see demilitarization below). All applications for the R&D must adhere to FAA Order 8130.29A *Issuance of a Special Airworthiness Certificate for Show Compliance and/or Research and Development Flight Testing*. A similar process should be identified to revert back from public aircraft operations.	
14.	Compliance With § 91.319 (a)(1)	Inform the operator that operations of the aircraft are limited under this regulation. The aircraft cannot be operated for any purpose other than the purpose for which the certificate was issued. For example, in the case of an experimental exhibition certificate, the certificate can be used for Airshow demonstrations, proficiency flights and flights to and from locations where the maintenance can be performed. Such a certificate is NOT IN EFFECT for flights related to providing military services (i.e., air-to-air gunnery, target towing, ECM simulation, cruise missile simulation, air refueling) for example. Also see *Military/Public Aircraft Operations* below.	
15.	Federally Obligated Airport Access	Inform the operator that L-39 operations may be restricted by airports due to safety considerations. As a reference, see FAA Order 5190.6B *FAA Airport Compliance Manual*.	
16.	Environmental Impact (Noise)	Inform the operator that L-39 operations may be restricted by airport noise access restrictions and noise abatement procedures in accordance with Title 49 United States Code § 47107. As a reference, see FAA Order 5190.6B *FAA Airport Compliance Manual*.	
17.	Other Federal Requirements	Owner/operators should familiarize themselves with directives from various government agencies. FAA regulations primarily have to do with aircraft certification and airworthiness standards pertaining to safe operation in U.S. airspace. While other agencies such as the Department of Defense (DOD), Department of Alcohol Tobacco, and Firearms (ATF), and Department of Homeland Security (DHS) have jurisdiction over import requirements, illegal substances, protection and other matters of national defense. As	

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		circumstances dictate constant vigilance and regulatory changes, it is the owner/operators responsibility for compliance.	
L-39 Maintenance Manual(s) and Aircraft Inspection Program (AIP)			
18.	Changes to Aircraft Inspection Program (AIP)	The FAA-accepted AIP may be subject to revisions to address safety concerns, alterations, or modifications to the aircraft. Section 91.415, Changes to Aircraft Inspection Programs, requires that "whenever the Administrator finds that revisions to an approved aircraft inspection program under § 91.409 (f) (4) or § 91.1109 are necessary for the continued adequacy of the program, the owner or operator must, after notification by the Administrator, make any changes in the program found to be necessary by the Administrator."	
19.	AC 43-209	AC 43-209 *L-39 Albatros Military Jet Recommended Inspection Program,* October 16, 2003, can be used as a reference in reviewing an L-39 AIP. This advisory circular (AC) provides a recommended inspection program for existing and new owners of L-39 Albatross aircraft operating under an experimental special airworthiness certificates.	
20.	Aero Vodochody (OEM) Support	Ask the applicant what services, if any, have been provided by the OEM (original Equipment manufacturer). Aero Vodochody provides support programs and services in the areas of logistic support, spare parts delivery, service-life extension, overhauls, special repairs, systems modifications, upgrades, ground and flight training, and flight testing. This is important because it can impact the mitigation of many of the safety issues discussed in this document.	
21.	Maintenance Practices	In addition to any guidance provided by the manufacturer/military service(s), consider Advisory Circular 43.13-2B *Acceptable Methods, Techniques, and Practices – Aircraft Alterations* and AC 43.13-1B *Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair,* to verify safe maintenance practices.	
22.	Modifications (General)	Comply with 14 CFR § 21.93 to verify that major changes do not create an unsafe condition and to determine whether new operating limitations will be required. The information contained in part 43 appendix A can be used as an aid. Note: A highly modified L-29 (for air racing) had a near-fatal in-flight engine fire that almost resulted in a total loss of control (burn through) while practicing for the Reno Air Races in 2010. Similar engine modifications have been made to L-39s, mostly for racing purposes.	
23.	After Market L-39 Modifications	Ask whether the aircraft has been modified. Modifications include: BSS-2000 Smoke System, Under Wing Tank Installation System, Accumulator Modification, Oil Reservoir Light, Video System, Pulse Lights, Tow Bar Installation, Stainless Steel Screw Kit, and Control Stick Modifications. If any of these modifications were made to the aircraft, verify that it is addressed in the AIP.	

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24.	Prioritize Maintenance Actions	Recommend the adoption of a risk management system that reprioritizes high-risks maintenance actions in terms of (a) immediate action, (b) urgent action, and (c) routine action. Also see *Record Keeping, Tracking Discrepancies and Corrective Action* below.	
25.	Record Keeping, Tracking Discrepancies and Corrective Action	Check applicant recordkeeping. The scope and content of 14 CFR §§ 43.9, 43.11 and 91.417 are acceptable. The USAF Form 781 process or the U.S. Navy's Maintenance Action Form (MAF) process will assist with recordkeeping and help verify acceptable level of continued operational safety (COS) for this type of aircraft. Three types of maintenance write-ups can be found inside the Form 781: (1) an informational, a general remark about a problem that does not require mitigation, (2) a red slash for a potentially serious problem, and (3) a red "X" highlighting either a safety of flight issue that could result in an unsuccessful flight and/or loss of aircraft – no one should fly the aircraft until the issue is fixed. For more information on record keeping, see AC 43.9C *Maintenance Records.*	
26.	Qualifications of Maintenance Personnel	Check for appropriate qualifications, licensing, and type-specific training of personnel engaged in managing, supervising, and performing aircraft maintenance functions and tasks. The NTSB has found that the use of non-certificated mechanics to perform the work on this type of aircraft has been a contributing factor to accidents. Recommend that only FAA-certificated repair stations and FAA-certificated mechanics with appropriate ratings as authorized by 14 CFR § 43.3 may perform maintenance on this aircraft.	
27.	Ground support, Servicing and Maintenance Personnel Recurrent Training	Recommend that regular refresher training be provided to ground support, servicing and maintenance personnel concerning the main safety issues surrounding servicing and flight line maintenance of the L-39. Such a process should emphasize a recurrent and regular review of the warnings, cautions, and notes listed in the applicable technical publications for the aircraft.	
28.	Parts Storage and Management and Traceability	Recommend establishing a parts storage program that includes traceability of parts.	
29.	Maintenance Records and Use of Tech Data	As required by FAA Order 8130.2G, conduct a detailed inspection of maintenance records. Verify that maintenance records reflect inspections, overhauls, repairs, time-in-service on articles, and engines, etc. Check that all records are current and appropriate technical data is referenced. This should not be a cursory review. Maintenance records are commonly poor or incomplete in many cases involving imported former Eastern Block aircraft like the L-39. See *Adequate Manuals and Related Documentation* above.	
30.	Adequate Maintenance Schedule and Inspection Program(s)	Review the AIP for compliance with manufacturer's inspection programs and/or applicable military service requirements (i.e., NATO Air Force), when developing an inspection program under 14 CFR § 91.409. A 100-hour, 12 calendar month inspection program under part 43, appendix D, is generally not adequate for sophisticated aircraft like the L-39. The inspection program must comply with both hourly (i.e., an inspection at 750 hours) and calendar (14 days, 6 months) inspection schedules and may exclude weapon	

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		and other military-specific components. Typical L-39 inspections include: 50-hour condition inspection, 100-hour routine inspection, 200-hour routine inspection, and a 400-hour routine inspection. See below for the 1,500/15 years inspection.	
31.	Czech Air Force L-39 Maintenance Concept	Recommend review of the Czech Air Force (CzAF) *L-39 Maintenance Concept.* This is important as background to understand any proposed maintenance inspection program being proposed. The Czech Air Force guidance states: "The L-39/59 aircraft had the maintenance concept based on phase inspections according to the number of flight hours. The interval of these inspections was 100 and 200 flight hours. Because of planning purposes, these phase inspections contained also periodic maintenance tasks, which would be otherwise performed according to calendar time, number of starts, number of landings, etc. Except of general kinds of inspections such as Pre-flight inspection, Thru-flight inspection, Post-flight inspection the CzAF implemented also the Preliminary inspection on the O level of maintenance, which after being performed had the validity for 6 flight days during 12 calendar days. The Preliminary inspection contained mainly some checks of systems, thus it was possible to simplify the Pre-flight inspection. This method was advantageous from the point of planning of maintenance, and it was suitable in cases when the aircraft units fly regular and high annual number of flight hours. Some work operations, however, were performed early. The CzAF achieved high readiness. The defects revealed during a flight day were eliminated until resolved. The main type of inspection at Organizational level of maintenance during a flight day was the Pre-flight inspection."	
32.	Airframe 1,500-hour or 15 Years Airframe Inspection	The L-39 has a 1,500-hour or 15-year overhaul inspection and many restorers adhere to this. The vast majority of Soviet block aircraft were manufactured and maintained with a service life limit that could only be extended following a manufacturer's overhaul. In following the manufacturer's requirements, there is no **"**administrative" extension over 15 years, but there is an "exact evaluation of the end of service life" and the ability to determine the "maximal available service life for each aircraft based on fatigue monitoring." Ask for supporting data for any prior service life extensions. Note: International Jets provides a "15-Year/1500-Hour" inspection.	
33.	Life Limits and Replacement Intervals	Verify compliance with required replacement intervals. If components are not replaced per the manufacturer's requirements, ask for data to justify extensions (e.g., 1,000 hours instead of 500 hours). Applicants should establish and record time in service for all life limited (replacement intervals) components and verify compliance with approved life limits. Adhere to manufacturer's data. Set time limits for overrun of intervals and track cycles. Evaluate any overruns of inspection or maintenance intervals. Concurrence should not be given automatically if it is in the proposed AIP or if the applicant requests it. If inspections or maintenance are overrun, a Special Flight Permit may be requested to fly the aircraft to a location where maintenance can take place. Examples of life limits and replacement intervals applicable to the L-39 include:	

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
		➢ SAPPHIRE GAS GENERATOR 3000 STARTS—OVERHAUL ➢ FUEL TANKS 10 YEARS—REPLACE ➢ LANDING GEAR (NOSE) 3000 LANDINGS/12 YEARS—OVERHAUL ➢ LANDING GEAR (MAIN) 3000 LANDINGS/12 YEARS—OVERHAUL ➢ ROCKET ENGINE 8 YEARS—REPLACE ➢ PARACHUTE 5 YEARS—REPLACE ➢ PARACHUTE STABILIZATION SYSTEM 5 YEARS—REPLACE ➢ TURBO-COOLER 1000 HOURS—OVERHAUL – 3000 HOURS—REPLACE ➢ FRONT WINDSHIELD SEALING HOSES IF HANGARED FULL-TIME, ON CONDITION IF NOT, 8 YEARS—REPLACE ➢ FRONT CANOPY SEALING HOSES IF HANGARED FULL-TIME, ON CONDITION IF NOT, 8 YEARS—REPLACE ➢ REAR CANOPY IF HANGARED FULL-TIME, SEALING HOSES ON CONDITION ➢ IF NOT, 8 YEARS—REPLACE HYDRAULIC PUMP 1200 HOURS—OVERHAUL ➢ HYDRAULIC ACCUMULATOR 1500 HOURS/8 YEARS—OVERHAUL ➢ HYDRAULIC PUMP – 1200 HOURS ➢ NITROGEN BOTTLE PER MANUFACTURER'S INSTRUCTIONS ➢ OXYGEN BOTTLE PER MANUFACTURER'S INSTRUCTIONS ➢ HYDROSTATIC TESTING (O_2 and N_2) – 5 YEARS ➢ FIRE BOTTLES - 3 YEARS ➢ TEMPERATURE REGULATOR 6000 HOURS—OVERHAUL RT-9-2 SERIES 8000 HOURS—REPLACE	
34.	On Condition Inspections	If "on condition" inspections are considered, adhere to the manufacturer's program and/or provide adequate data to justify that practice for the applicable part or component. On condition inspections are not appropriate to all parts and components. For example, there is no "on condition" inspections for ejection seat pyrotechnics nor should "on condition" inspections replace time limitations. "On condition" inspections must reference an applicable standard or/and a set of tolerances (i.e., inspect the fuel pump to an acceptable reference standard, not just "it has been working" or "has been visually inspected").	
35.	Service Bulletins	Recommend compliance with the manufacturer's L-39 service bulletins. The manufacturer, Aero Vodochody, publishes service bulletins.	
36.	Whether an IRAN Replaces or Supplements Other Inspections	If inspect and repair as necessary (IRAN) is proposed, verify that it is detailed and uses adequate technical data (references to acceptable technical data) and adequate sequence for its completion. An IRAN must have a basis and acceptable standards. It is not analogous to an "on condition" inspection.	
37.	Aircraft Storage	Verify that the applicant has a program to address aircraft inactivity and specifies specific maintenance	

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	and Returning the Aircraft to Service After Inactivity	actions for return to service per the L-39 inspection schedule. Note: Some former Soviet Block aircraft use *Aircraft Storage* guidance which calls for specific inspections after 10.5 days of inactivity for example.	
38.	Specialized Tooling for L-39 Maintenance	Verify that adequate tooling, jigs, and instrumentation are used for the required periodic inspections and maintenance per the L-39 maintenance manuals.	
39.	AI-25 Engine Time Between Overhaul (TBO)	Verify that the applicant has established an appropriate TBO/replacement interval specific to the engine sub-type and serial number and adheres to those limitations. Manufacturers engine overhaul/component replacement recommendations for different engine serial numbers varies from 300 hours to 1,000 hours. TBO would vary depending on the engine "series," which include 905 series and the 708 series. "On condition" or "visual" do not replace manufacturer's inspection processes and replacement times. Justification and FAA-acceptance is required for a higher TBO. Note: Several AI-25 engines lack documentation and have been represented to be of a higher TBO range than they actually are. There must be data on TBO/time remaining on the engine at time of certification. It is also critical to document those throughout the aircraft life cycle.	
40.	Manufacturer's Engine Modifications	Verify that the AIP addresses the incorporation of the manufacturer's modifications to the AI-25 engine installed. The NTSB and other foreign civil aviation authorities have determined that a factor in accidents is the failure of the various post military surplus operators to incorporate the manufacturer's recommended modifications to prevent engine failures.	
41.	Materials Modifications to Engine Not Approved by Manufacturer	Determine if an installed AI-25 engine was serviced and altered by LOM Co., in the Czech Republic (i.e., logbook entry and documentation). LOM incorporated unapproved alterations on some AI-25 engines to the engine without consulting the original Ukrainian designer and producer, Motor-Sich. The problem is that LOM technical engineers replaced certain titanium parts in the engine with steel ones. These unapproved alterations caused several fatal L-39 accidents.	
42.	Civil Aviation Authority (CAA) AD No. 1-1-26/05/1 *AI-25TL Engine*	Verify the AIP addresses the scope and intent of Estonia CAA's AD No. 1-1-26/05/1 *AI-25TL Engine.* This is a critical safety of flight issue. The AD documents first stage blade burnout. First stage blade burnout is possibly due to (1) not adhering to engine start-up procedures, (2) using emergency fuel feed mode, (3) engine stopping, or (4) airflow disturbance during flight.	
43.	Engine Thrust	Verify that the AIP addresses measuring actual thrust of the engine and tracking engine operating temperatures.	
44.	Turbine Flame Inspection	Recommend that the AIP incorporates a method to conduct a turbine flame inspection. The combustion of the jet fuel–air mixture must be completed in the combustion chamber to avoid hot spots on the turbine stator and a partial overload of the turbine cooling system. These issues can result in melted leading edges or the total loss of turbine blades.	

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45.	Ruptured Oil Lines	Inspect and replace oil lines. Ruptured oil lines have been linked to AI-25 engine fires. In fact, a National Transportation Safety Board (NTSB) accident report noted: "A ruptured oil line, which resulted in oil spraying onto the APU exhaust and a subsequent fire."	
46.	AI-25 Engine Freewheeling in the Wind for Extended Periods	Recommend using engine plugs, as required, after engine shutdown. Allowing the AI-25 engine to freewheel in the wind for extended periods can damage the engine. The AIP should provide for engine inspection if the engine was not protected. Note: This was a contributing factor in engine failures at start-up. It was also related to extended periods of outside storage and not being run regularly. Regular, scheduled maintenance and trend monitoring were required to operate the engine.	
47.	Engine Failure Due to Multiple Causes	AI-25 engine failures have multiple causes. It is recommend that AIP cover: (1) compressor washes at each annual/100 hour inspection or at each 50 hour inspection if the engine is operated in sandy/dusty areas, (2) parameter records of tech ground runs after each 15 days, with the record of the parameters in the original logbook, (3) Boroscope inspection at each 100 hrs, and (4) APU performance check, monitoring of N-1 RPM before ignition and APU shut off RPM. Improper fuel management after the fuel control unit (FCU) exchange can worsen the situation by adding additional thermal stress to the turbine. See http://www.l39.com for additional information.	
48.	Inspection Report L-39ZO "G-OTAF"	Recommend review and consideration of *Inspection Report L-39ZO "G-OTA,"* August 8-9th, 2003, Duxford Airport /UK. This report investigates the forced landing after an engine failure. It was performed by Dipl.-Eng. Bernd Rehn, licensed by AERO-Vodochody. See http://www.l39.com/sites/all/docs/newsletters/200309a.pdf.	
49.	Ice Accretion System Transmitter and Engine Igniters /Ignition System SKN-II-I Contains Radioactive Isotopes	Emphasize the dangers (e.g., radiation and high-voltage) in terms of training, maintenance procedures, hazmat procedures, and marking. Contingencies may have to be adopted for handling such a situation, including other Federal, State and local requirements. The transmitter of the ice accretion system, on the left underside of the nose, must have a special cover installed when the aircraft is on the ground. It can be removed by the pilot when entering the cockpit. The engine ignition system (high-voltage energy source) contains built-in radioisotopes. Neither system should be dismantled. If any part of the transmitter of the ice accretion system or the high-voltage energy source is damaged, it must be specially wrapped and disposed of following Environmental Protection Agency (EPA) guidelines. U.S. Nuclear Regulatory Commission (NRC) licensing and other protection and disclosure requirements may also apply. See http://www.nrc.gov/about-nrc/contactus.html. U.S. Army Technical Bulletin 43-0108 *Handling, Storage, and Disposal of Army Aircraft Components Containing Radioactive Materials* and FAA Order 8020.11C, *Aircraft Accident and Incident Notification, Investigation, and Reporting*, may be used as references.	
50.	Fuel Control Unit (FCU) Settings	Verify that the AIP addresses that the Fuel Control Unit (FCU) is set to verify that the engine does not flame out when the throttle is brought back to idle, at any airspeed or altitude within the aircraft's flight	

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		envelope. An L-39 accident investigation noted this.	
51.	Sapphire 5 APU TBO	The TBO for the Sapphire 5 APU is 3,000 starts. If any request for an extension is made, such as 4,500 starts, adequate data from the manufacturer must be provided. These data must show, in technical terms, why the TBO can be extended. This is necessary because since the introduction of the L-39 into the U.S., and based on previous data from the manufacturer, and user input, the 3,000 starts limit was accepted as the limit.	
52.	Incorrect Oil in Sapphire 5 APU	Use mineral oil per the manufacturer, not synthetic oil. L-39 APUs have been prematurely worn out from using synthetic oil.	
53.	Broken Wiring on Sapphire 5 APU	Verify that the AIP provides for the inspection and repair of broken wires in the cannon plug of the RPM sensor on the cable.	
54.	Fire Suppression System	Verify that the fire suppression system (Halon 1301 or Halon 2402) is properly serviced and adhere to replacement intervals. Several L-39 engine fires were not caught early by the pilot due to an inoperative fire detecting system. Also, verify proper condition of the sensors and the BI-2I box. For additional information, see Aero-Contact's *The Fire Extinguisher Installation of the L-39* (http://www.l39.com). Note: Address any applicable issues concerning the Halon such as alternatives and environmental requirements. Halon may have EPA or other health restrictions. See *Guidance for the EPA Halon Emission Reduction Rule* (40 CFR part 82, Subpart H).	
55.	Servicing and Engine Fires	Verify the operator warns servicing personnel via training and markings of the fire hazard of overfilling (1) oil, (2) hydraulic, and (3) fuel tanks. Lack of experience with L-39 servicing is a safety concern.	
56.	Magneto Plug for Chip Detection	The AIP should provide for the inspection and repair as per the manufacturer's requirements. In some L-39s, "the magnetic plug for chip detection was inspected since the airplane came out of military service but the magnetic chip detectors were still safety wired with old corroded Russian safety wire." Note: It is important, in pre-flight and post-flight, to open the engine and inspect the magnet plug for the chips from the gear box.	
57.	Engine Start	There should be provisions and procedures to document all unsuccessful starts. This is useful in documenting engine problems.	
58.	Engine Storage	The storage of the AI-25 engine is an important issue in ensuring safe L-39 operations. Review AI-25 engine storage methods, and ascertain engine condition after storage, to include actual calendar time since overhaul. Calendar times will have an impact on the inspection of the engine (see table below). Accidents have occurred because engines were not overhauled when they needed to be. A 2003 accident caused by an engine failure shows that the engine, although being within the 750 hours (time) limit for an overhaul, was last overhauled in (calendar) 1982. As a reference, it is noted that current FAA guidance affecting	

<table>
<tr><th>Issue #</th><th>Issue(s)</th><th>Recommended Review, Action(s), and Coordination with Applicant</th><th>Notes, Action(s) Taken, and Disposition</th></tr>
<tr><td></td><td></td><td>experimental exhibition former military jet aircraft states: “Engines which have exceeded storage life limits are susceptible to internal corrosion, deterioration of seals and coatings, and breakdown of engine preservation lubricants.”
Storage Life Limits for Properly Preserved Engines<table><tr><th></th><th>Moderate Climate Conditions</th><th>Tropical Climate Conditions</th></tr><tr><td>Engines in sheltered storage areas</td><td>6 years</td><td>3 years</td></tr><tr><td>Engines in unsheltered storage areas</td><td>3 years</td><td>1 year</td></tr></table></td><td></td></tr>
<tr><td>59.</td><td>Engine Condition Monitoring</td><td>Establish an engine oil sampling program (SOAP) at intervals of less than 10 hours. If baseline data exists, this can be very useful for failure prevention. If manufacturer baseline data does not exist, this may still warn of impending failure.</td><td></td></tr>
<tr><td>60.</td><td>Engine (FOD)</td><td>Verify adoption of a FOD (Foreign Object Damage) prevention program (internal engine section, external, and air intake).</td><td></td></tr>
<tr><td>61.</td><td>Bleed Air Pipe for the Engine Intake Heating System Can Fail (Explode)</td><td>Verify proper installation and inspection. In a recent Dutch L-39 incident, the full blowing bleed air reduced power such that the plane had almost no climbing power.</td><td></td></tr>
<tr><td>62.</td><td>Start Control of the (FCU) Contamination (Particulates)</td><td>Verify proper installation and inspection of the FCU (Fuel Control Unit) and these processes address the possibility that the start control of the FCU can be contaminated causing the diaphragm to stick.</td><td></td></tr>
<tr><td>63.</td><td>Use of Different Fuels</td><td>Verify that the AIP and operational procedures consider the type of fuel impact on AI-25 inspection and maintenance program. Note: Soviet fuels (T-1 and TS-1) used a high level of hydrogen. Also, variations in fuels (i.e. AvGas content) may have an impact on burner can (i.e., hot section inspection dropping down) inspections.</td><td></td></tr>
<tr><td>64.</td><td>Fuel Tank Leaks and Fuel Bladders</td><td>L-39 fuel tanks can leak. Adhere to the maintenance schedule for fuel tank bladders or provide adequate technical data to show an equivalent level of safety. Inspect as necessary as required by manufacturer. The age of the aircraft dictates this practice. The fuel bladders in the L-39 have an 8-10 year replacement interval. However, many owners/operators state that an “on condition” inspection is adequate, even in cases involving fuel bladder that have reached 25 years of age. Without adequate data, this is not</td><td></td></tr>
</table>

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		acceptable, and even if there is data, it should address a limited extension, not doubling the component's life limit or extending its life limit in perpetuity.	
65.	Accidental Fuel Shut-Off	The AIP should include provisions to check the mechanism that prevents accidental fuel cut-off on the front cockpit thrust lever. They can become loose to the point that accidental fuel-cut-off can occur.	
66.	Seized Airflow Limiter	AIP should provide for the inspection of both limiters during the next maintenance event. On an L-39C, two turbo coolers were destroyed by excessive RPMs within 4 days because the air flow limiter was seized by corrosion/dirt and blocked in the full opened position.	
67.	Oil, Fuel, and Hydraulic Fluids	Develop and use a list of equivalents of materials for replacing oil, fuel, and hydraulic fluids per the manufacturer requirements. There have been several cases of AI-25 engine failures caused by use of incorrect fluids. A good practice by many operators is to include a cross reference chart for NATO and US lubricants as part of the AIP.	
68.	Hydraulic System Problems	Adhere to manufacturer's inspection guidelines and replacement times. Hydraulic system problems include: (1) dirty hydraulic filters, (2) low pressure in emergency system, (3) inoperative accumulators, (4) inadvertent hydraulic system failure light ON, (5) hydraulic fluid draining in tail pipe, (6) low bleed air pressure of hydraulic tank, and (7) low hydraulic pump output pressure. Note: Some L-39 operators replace original accumulators with U.S. accumulators.	
69.	Oil Contamination of Hydraulic System	Verify that the AIP provides for an inspection to prevent hydraulic fluid from contaminating the oil system.	
70.	Oil Pump Failure and Fill Levels	Inspect or replace oil pump. In May 2011, a French Aero L-39 Albatross crash-landed due to engine seizure following an oil pump failure. An L-39 inspection noted: "Engine Oil level was found at 5.5 with engine not running. After engine start the oil level is at 4.5 liters, the absolute minimum. Do not fly that airplane unless oil has been checked and serviced."	
71.	Electrical System and Batteries	Verify that the AIP provides for the functionality of the generator and the compatibility of the aircraft's electrical system with any new battery installation.	
72.	Engine Cooling NACA Inlets	Verify an operator does not close engine cooling NACA inlets. Some operators do it for performance reasons, i.e., air racing. However, although closing NACA inlets can make the airplane more aerodynamic, it can impact cooling which creates a fire hazard leading to hydraulic pump failure (burning) due to the increasing temperature of the hydraulic fluid in the tank.	
73.	Inlet Directing Body (IDB)	Verify that the AIP provides for the inspection (torque check) of the IDB mechanism per Service Bulletin Ivchenko Progress 225000521. This has been linked to accidents. Following a UK L-39 accident, the UK's AAIB noted: "The AAIB could not determine the cause of the engine failure but the IDB blades were found	

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		seized and this could have been a contributory factor. The IDB mechanism seizure could have been avoided had the service bulletin been carried out or had the engine been overhauled. Therefore, the AAIB issued the following safety recommendations: Safety Recommendation 2004-91: It is recommended that the UK Civil Aviation Authority considers mandating a calendar time limitation between overhauls for Ivchenko AI-25TL engines. Safety Recommendation 2004-92: It is recommended that the UK Civil Aviation Authority takes appropriate action to inform owners, operators and maintainers of L-39 type aircraft of the need to check that the Inlet Directing Body (of the high pressure compressor) operates correctly in accordance with Service Bulletin Ivchenko Progress 225000521."	
74.	Pitot/static, lighting, and avionics and instruments	Verify compliance with all applicable 14 CFR requirements concerning the pitot/static system, exterior lighting (i.e., adequate position and anti-collision lighting) and transponder. Maintain and inspect all avionics and related instruments.	
75.	Cracks in Rubber Pitot Static Lines in the Main Landing Gear (MLG)	The AIP should provide for inspection and replacement of these items. These are most exposed to the weather in each MLG well, behind the landing gear suspension in the wing, and behind the pitot tube in the wing. They have to be checked frequently. This can have an impact on instrumentation and can cause the ejection seat to work in the wrong mode – acting as if the aircraft was at altitude and not separating the pilot at low level.	
76.	Oxygen System	Emphasize the inspection of the oxygen system and any modifications. The L-39 requires a functional, well-maintained oxygen system for high-performance flight. Compliance with 91.211 *Supplemental Oxygen* is required and recommend adherence to 14 CFR Part 23.1441 *Oxygen Equipment and Supply.* Moreover, as per FAA Order 8900.1 Change 124, chapter 57 *Maintenance Requirements for High-Pressure Cylinders Installed in U.S. Registered Aircraft Certificated in Any Category*, each high-pressure cylinder installed in a U.S. registered aircraft must be a cylinder that is manufactured and approved under the requirements of 49 CFR, or under a special permit issued by Pipeline and Hazardous Materials Safety Administration (PHMSA) under 49 CFR part 107. There is no provision for the FAA to authorize "on condition" for testing, maintenance or inspection of High Pressure Cylinders because the oversight is title 49 (PHMSA). The O_2 bottles are time sensitive items, usually with 10 years for hydrostatic testing. The issue is when the bottles are removed from the aircraft. As an industry member states, in those cases where Eastern Block bottles are installed, "and they are within their hydrostatic test dates, all is good. Where [one of] the problems lies is removing them for hydrostatic testing. Maintenance programs require these bottles to be hydrostatic tested. Once the Russian or Czech bottles are removed from the aircraft, they are not supposed to be hydrostatic tested, recharged or reinstalled in any aircraft." Moreover, they can't be serviced (on board) after the testing date has expired. There are indications that some U.S. bottles may be used instead of Russian/Czech bottles. An L-39 service provider makes a replacement kit for the L-39. In addition, the installation of U.S. oxygen regulators has also been reported. Note: The manufacturer provides for an On-Board Oxygen Generation System (OBOGS) installation.	

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77.	N_2 Bottles	Emphasize the inspection of the N_2 system in the AIP. As per FAA Order 8900.1 Change 124, chapter 57 *Maintenance Requirements for High-Pressure Cylinders Installed in U.S. Registered Aircraft Certificated in Any Category*, each high-pressure cylinder installed in a U.S. registered aircraft must be a cylinder that is manufactured and approved under the requirements of 49 CFR, or under a special permit issued by Pipeline and Hazardous Materials Safety Administration (PHMSA) under 49 CFR part 107. There is no provision for the FAA to authorize "on condition" for testing, maintenance or inspection of High Pressure Cylinders because the oversight is title 49 (PHMSA). The N_2 bottles are time sensitive items, usually with 10 years for hydrostatic testing. The issue is when the bottles are removed from the aircraft. As an industry member states, in those cases where Eastern Block bottles are installed, "and they are within their hydrostatic test dates, all is good. Where [one of] the problems lies is removing them for hydrostatic testing. Maintenance programs require these bottles to be hydrostatic tested. Once the Russian or Czech bottles are removed from the aircraft, they are not supposed to be hydrostatic tested, recharged or reinstalled in any aircraft." Moreover, they can't be serviced (on board) after the testing date has expired. There are indications that some U.S .bottles may be used instead of Russian/Czech bottles. An L-39 service provider makes a replacement kit for the L-39.	
78.	Fire Bottles	Emphasize the inspection of the fire bottles in the AIP. As per FAA Order 8900.1 Change 124, chapter 57 *Maintenance Requirements for High-Pressure Cylinders Installed in U.S. Registered Aircraft Certificated in Any Category*, each high-pressure cylinder installed in a U.S. registered aircraft must be a cylinder that is manufactured and approved under the requirements of 49 CFR, or under a special permit issued by Pipeline and Hazardous Materials Safety Administration (PHMSA) under 49 CFR part 107. There is no provision for the FAA to authorize "on condition" for testing, maintenance or inspection of High Pressure Cylinders because the oversight is title 49 (PHMSA). The fire bottles are time sensitive items, usually with 5 years for hydrostatic testing. The issue is when the bottles are removed from the aircraft. As an industry member states, in those cases where Eastern Block bottles are installed, "and they are within their hydrostatic test dates, all is good. Where [one of] the problems lies is removing them for hydrostatic testing. Maintenance programs require these bottles to be hydrostatic tested. Once the Russian or Czech bottles are removed from the aircraft, they are not supposed to be hydrostatic tested, recharged or reinstalled in any aircraft." Moreover, they can't be serviced (on board) after the testing date has expired. There are indications that some U.S. bottles may be used instead of Russian/Czech bottles. An L-39 service provider makes a replacement kit for the L-39.	
79.	Cockpit FOD	To preclude inadvertent ejection, flight control interference, pressurization valves clogging and other	

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		problems, verify that the AIP addresses thorough inspection and cleaning of the cockpit area. This is a standard USAF/U.S. Navy practice.	
80.	Canopy	The AIP should address the proper maintenance of transparencies. Monitoring and inspection of the canopy for crazing should be conducted at every 10 hours of flight. Canopy failures, de-laminations and Plexiglas deterioration are common with Soviet block transparencies. Procedures should address this in the AIP and as part of post-flight procedures.	
81.	In-Flight Canopy Separation	The AIP should address the proper maintenance of canopy locks. The NTSB noted that the in-flight failure and separation of the canopy was a contributing factor to an accident. An inspection of an L-39 found that "during the course of inspection of the canopy system, both front canopy locks of the rear cockpit were inoperative." Another L-39 inspection found that the canopy twisted when the canopy locks are closed. In relation to a May 2012 fatal L-39 accident, L-39 industry experts note that "it is possible for the canopy lock light to show the canopy safe when in fact it is not completely locked," and add that "the current AC does not address this problem in the language for 100 hour annual condition inspections and hence many operators are not aware of this issue." As a result, these industry experts recommend inspections of the locking mechanism. Specifically: (1) inspection of the micro switches in the front and rear canopy lock mechanism and determine functionality and alignment, (2) inspection of the aircraft for any foreign objects that may interfere with the right side latching mechanism, (3) inspect the canopy hold open bar hold open bar for bends and damaged, and (4) inspect of the canopy latches. All of this should be done in accordance with the Aero Vodochody factory maintenance manual. An UK L-39 accident investigation noted that "the pilot shut both canopies before takeoff but the canopy "unlocked" light remained illuminated. Visual inspection confirmed that, the external locking handles appeared to be stowed correctly and the pilot believed that the micro switch that operated the "unlocked" light was incorrectly adjusted. During the takeoff, the rear canopy detached and came to rest beside the runway. The aircraft returned to the airfield safely, having sustained no further damage. An investigation revealed that the locking handle can be stowed without first locking the canopy, and that correct operation of the lever is the only means of ensuring that the canopy is secure. Note: An incorrectly adjusted canopy jettison system can be critical in case of an emergency.	
82.	Cockpit Instrumentation Markings	Verify that all Soviet/Czech style lettering and symbology are replaced with English and proper terminology. This is an important safety of flight issue and some aircraft are operating with original cockpit markings. Aircraft instruments must be in the English language and in U.S. standard units.	
83.	Annunciator Panel	Recommend that the main original annunciator panel be replaced with one in English.	
84.	Corrosion Due to Age and Inadequate Storage	Evaluate adequacy of corrosion control procedures. Age, condition, and types of materials used in the L-39 may require some form of corrosion inspection control. Ask whether a corrosion control program is in place. If not, ask for steps taken or how it is addressed in the AIP. Note: finish damage, moisture	

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		entrapment, and surface corrosion on flight control push rods and bearings are common with the L-39. An emphasis on critical flight items like main structural elements, attach points, and flight controls should be made since corrosion has also been noted in L-39 horizontal tail structures. An L-39 inspection found corrosion in the engine due to outside storage, and the damaged areas included: RPM-transmitters, nuts, bolts, and safety wires. TO 1-1-691, *Corrosion Prevention and Control Manual can be used as a reference.*	
85.	Cycles	In addition to hours and calendar time, inquire if airframe and engine cycles are tracked. This helps increase safety margins and is a safe practice with an engine type like the AI-25, where cycles can supplement hours.	
86.	Pressurization Vessel	Emphasize the pressurized sections of the aircraft (cockpit) as part of inspections, pressure-cycles, and note pressurized area repairs.	
87.	Safety Markings and Stenciling	Verify that appropriate markings (i.e., safety stenciling and "Remove Before Flight" banners) are in English and applied to those areas of the aircraft that could be dangerous to anyone unfamiliar with the aircraft, including areas such as intakes, exhaust, air brakes, and ejection seats. Note: With regards to ejections seat systems, as noted in FAA Order 8130.2G, "a special airworthiness certificate will not be issued before meeting this [marking] requirement."	
88.	Larger Wing Tip Fuel Capacity	Recommend that increased fuel capacity wing tip tanks not be used. An increase in fuel capacity in the wing tip fuel tanks cannot be a "home-made" addition to the L-39, in an attempt to increase the aircraft's range. There are too many technical issues (stability, fatigue) that would have to be addressed and that may not have been properly addressed by the manufacturer. Note: If added, there must be data (i.e., engineering, flight tests) and it should be reviewed. Also, verify that all metric fuel measures are understood.	
89.	Tires and Wheels	Verify use of proper tires and/or equivalent substitutes (including inner tubes) and adherence to any tire limitation. Wheels must be properly and regularly inspected and balanced.	
90.	Pneumatic System	Emphasize the inspection of the pneumatic system and any modifications. Some L-39 restorers install new components to the aircraft's pneumatic system like a "self-contained air pump system (automatically charges pneumatic system)."	
91.	Bulkhead 32 Cracks	Cracks at bulkhead 32 have been found in certain L-39s and these were likely caused by the frequency differences between the engine and the airframe and installing hydraulic lines under tension. The AIP should address this and adhere to the intent and scope of the 1979 manufacturer service bulletin on this which incorporated a riveted patch.	
92.	Explosives and Propellants	In addition to verifying that manufacturer's and service requirements are followed, check compliance with applicable Federal, State, and local requirements for explosives and propellants in terms of use, storage	

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		and disposal.	
93.	Canopy Seals	Verify that the AIP addresses the testing of canopy seals for nitrogen leaks. On the L-39, nitrogen leaks can occur while pressurized. Verify that the system is topped off and has the correct fittings that mate to a U.S. standard Schrader valve.	
94.	Cracked Stiffeners in Aileron Section	The AIP should provide for the inspection, repair, replacement as necessary and proper balance.	
95.	Control Hinges Lubrication	Verify that the AIP provides for the correct lubrication of control hinges. Control hinges, control rod end bearings, and bell cranks are packed with grease (Lubriplate 630, Aeroshell #22, or similar grease) at assembly. During inspections it is generally not necessary to disassemble each control rod end to grease. Use of LPS-2 will displace moisture and maintain a film of lubrication.	
96.	External Fuel Tanks	Verify that the type, condition, installation, and removal of drop tanks meet requirements of the manufacturer or military operator. Only external tanks cleared for use by the aircraft manufacturer and NATO may be used on the aircraft. Verify drop tanks are cleared for use in the specific aircraft, L-39ZA 150 liters drop tanks P/N 36 67 64 00. Accidental jettisoning of the tanks in flight and on the ground is a safety hazard. Any means of releasing the tanks during aircraft operation must be disabled. The only modification allowed to the external tanks is to prevent jettisoning.	
97.	Old Hoses and Cables	Inspect and replace appropriately. This is a critical flight safety item with the L-39 due to materials quality and age.	
98.	Incorrect Rudder Pedals Adjustment	Verify the AIP provides for proper rudder pedal installation, movement, and freedom from any obstruction. An L-39 inspection noted that the “rudder pedals was in most forward position. L/H pedal had no full deflection and the pilot’s foot hit the cable bundle...”	
99.	Grounding	Verify that adequate procedures are in place for grounding the aircraft.	
100.	Installation of Auxiliary Fuel Tanks or Smoke Oil Tanks in the Former Radio Equipment	Installation of auxiliary fuel tanks or smoke oil tanks should not be installed in the former radio equipment area aft of cockpit because of the potential for creating a safety hazard. Any installation of auxiliary fuel tanks or smoke oil tanks in the size/volume exceeding the former radio equipment installed in this section aft of the cockpit (a) disturbs the cooling air flow and reduces the amount of air going through the blast hole around the engine inlet, (b) reduces the safety margin (fire protection between engine compartment and fuel tanks) to zero, and (c) limits effectiveness of fire suppression system.	
101.	Wheel Brake System Inspection	The AIP should provide for proper inspection of the main wheel brake system and related components, including the weight on wheels (WOW) switch. Improper towing may bend and jam the WOW switch in the in-flight position. The WOW switch can also have loose wires that can render it inoperative. There have	

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		been several cases of L-39 brake failures.	
102.	Hard Landings, Over G Situations, and Tail Strikes	Verify that hard landing, over-G, and tail strike inspection programs are adopted. This is especially important when acrobatics are performed or when the aircraft is involved in military support missions outside of the scope of its experimental certificate (i.e., public aircraft operations).	
103.	Wing and Tail Bolts and Bushings	Inquire about inspections and magnafluxing of these items. Recommend that the AIP incorporate other commonly used and industry accepted practices involving non-destructive inspection (NDI) if not addressed in the manufacturer's maintenance and inspection procedures.	
104.	Flight Control Balancing and Repairs	Verify flight controls were balanced per the maintenance manual(s) after materials replacement, repairs, and painting. Note: Damage to flight controls has been noticed when inadequate repairs have been performed. If there are no adequate records of the balancing of the flight controls, the airworthiness certificate should not be issued.	
105.	Flight Controls Rigging and Deflection	Verify proper rigging and deflection. If there are no adequate records of the proper rigging and deflection of flight controls, the airworthiness certificate should not be issued.	
106.	Automatic Flap Speed Sensor	The AIP should provide for proper inspection of the flap speed sensor and related components. The malfunction of this system is a very serious safety issue because the flaps can change position on their own at critical phases of flight such as during take off. In addition, it can be catastrophic if they retract on short final while the aircraft is in the full flap configuration. L-39 owners have reported the following possible causes for this problem: (1) "internals going bad and that a new switch might be needed." (2) "this failure can also be caused by having a broken rubber stand off on the mounting mechanism that holds the cylinder to the fuselage wall." (3) "a faulty external (out under the wing) flap position sensor switch and a test box that can be used to check the preset speed setting for automatic flap retraction and the external flap position switch can be validated via a volt meter." (4) "that it could be a micro switch setting problem on rib "0" in the left or right gear well, the one where the Flap actuator is mounted on top and this can be caused in flight by vibration or in this case definitely with touch down."	
107.	Replacement of Magnesium Skin With Aluminum	The AIP should address any and all modifications and balancing after skin replacement. This is because several owners replace the magnesium alloy skin on their L-39 elevators or rudder with aluminum alloy. Corrosion must be addressed and mitigated.	
108.	Parts Fabrication	Verify engineering (i.e., Designated Engineering Representative (DER)) data supports any part fabrication by maintenance personnel. This is an issue because it is a common practice in L-39 restorations. Unfortunately, many of these modifications have been made without adequate technical and validation data. AC 43.18 *Fabrication of Aircraft Parts by Maintenance Personnel* may be used for guidance.	
109.	Accurate Weight &	Verify original W&B records meet FAA-H-8083-1 if documentation by the applicant appears inadequate.	

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	Balance (W&B) Basic References and Calculations	There have been L-39 accidents that were related to inadequate W&B baseline data. The NTSB determined that a contributor factor to a 2001 L-39 fatal accident was the airplane's improper aft weight distribution. If there are no adequate records of the proper W&B data, the airworthiness certificate should not be issued.	
110.	Anti-G Suit System	If installed, verify its serviceability.	
111.	KL-39 Check-Out System	The system should be used if available. This comprehensive automatic check-out system can be hooked to the aircraft by means of cables and hose connections. A total of 236 parameters can be checked, including 42 electric, 19 instrumentation, 16 for the engine, 12 for each hydraulic system and starter, and 2 for pressurization.	
112.	"Experimental" Markings	Verify that the word "EXPERIMENTAL" is located immediately next to the canopy railing, on both sides, as required by 14 CFR part 45.23(b). No subdued markings.	
113.	N-Number	Verify that the marking required by 14 CFR part 45.25 and 45.29(b) concerning registration number (N-number), its location and size are complied with. If non-standard markings are proposed, verify compliance with Exemption 5019, dated February 16, 1989 under regulatory docket No. 25731.	
114.	NATO L-39 Safety Supplements	Verify the applicant/operator has copies of the applicable NATO Safety Supplements for the L-39 and that they are incorporated into the AIP or operational guidance as appropriate. The most current version of the Airplane Flight Manual (AFM) (or "-1", the T.O. number for AFM) usually provides a listing of affected Safety Supplements and this can be used as a reference.	
115.	Additional Issues to Consider in L-39 AIP	Ask whether the AIP addresses the following items: Ejection Seat Handles and Brake Control Valve, Pressurization and Wing Inspections and Replacement Canopies and Canopy Locks, Zero Flap Takeoff Profile and Flaps Maintenance, Inverters, Landing Gear Doors, Drop Tank Operation, Air Conditioning and Canopies Hydraulic Accumulators, Engine Compressor IDB Check, Engine Heat APU/RPM Cable, Engine Bypass Skin Cracks, Proper Torque and Fuel Cells, Inverted Flight Fuel Accumulators, Elevator Bearing Maintenance, Thermo sensor LUN 5626 (200 Ohm) for Environmental Temperature, and Missing Fuses and Water Separator Hoses. See L-39 *Technical Letters* at http://www.l39.com/content/newsletter-archive for additional issues with the aircraft.	
L-39 Operational Issues and Limitations			

Issue #	Issue(s)	Recommended Review, Action(s), and Coordination with Applicant	Notes, Action(s) Taken, and Disposition
116.	AIP and Related Documentation	As part of the operating limitations, the operator must adhere to the AIP and related documentation.	
117.	L-39 Pilot in Command (PIC) Requirements	As a matter of policy, the FAA requires that a pilot have a total of 1,000 hours before they can be issued an authorization to act as PIC of an experimental jet unless they were trained by the US military as a jet pilot. Refer to the appropriate pilot authorization policy. Recommend proficiency and currency of 3 hours per month and 5 take-offs and landings. Also recommend a minimum of 10 to 15 hours of dual training. Note: The USAF restricted to two the number of aircraft types a pilot could hold currency on.	
118.	Adequate Annual Program Letter	Many applicants/operators submit inadequate and vague program letters and fail to submit them on an annual basis. Verify that the applicant's annual program letter is detailed enough and consistent with the applicable regulatory and policy requirements. Also verify that the proposed activities (i.e., an air show at a particular airport) is consistent with the applicable operating limitations (i.e., avoiding populated areas) and does not pose a safety hazard, such as the runway being too short. See http://www.warbirds-eaa.org/forms/	
119.	Flight Manuals and Operating Limitations	PIC must operate the aircraft as specified in the English L-39 Flight Manual for the appropriate L-39 version and the FAA-approved operating limitations.	
120.	Maintenance and Line Support	For safety reasons, qualified crew chief/plane captains should be used for safe L-39 pre-flight and post-flight inspections, in addition to assisting the PIC during start-up and shutdown.	
121.	Flight Servicing Certificate	Recommend that a Flight Servicing Certificate or a similar document be used by the ground crew (i.e., crew chief or plane captain) to attest to the aircraft's condition (i.e., critical components such as tires, drag chute) before each flight to include the status of all servicing (i.e., liquid levels, fuel levels, nitrogen levels, oxygen). Note: A crew chief (USAF) or plane captain (U.S. Navy) is the person (a noncommissioned officer) who is in charge of the day-to-day operations, maintenance and ground handling of an aircraft.	
122.	Type of Ejection Seat System	Determine the type of ejections seat system installed. This is important to establish the appropriate safety requirements since the sophistication and flight envelope of the ejection seat varies among ejection seat systems. Note: The manufacturer provides for an upgraded escape system (VS-2 ejection seat), and it is a more complex system than the VS-1.	
123.	VS-1-BRI Ejection Seat System PIC Training	Require adequate PIC ejection training for PIC and crew (if applicable). The available record shows that none of the attempted L-39 ejections were successful. This suggests a major deficiency in training leading to ejections outside of the ejection envelope. The operator should have an adequate training program. Recommend that operator seek training from companies specializing in such services. Notes: Survival rates of civilian ejections are poor, especially in L-39s. There are three documented ejections (2002, 2003 and 2006) by civilian pilots that were fatal. A simple briefing or a general familiarization course is not enough, especially for the PIC. Past experience with other ejection seat systems, such as those found in U.S. military	

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		aircraft, does not necessarily qualify the PIC to verify safe operations with the VS-1 or VS-2 systems.	
124.	VS-1-BRI Ejection Seat System Maintenance	Maintenance and inspection of the ejection seat and other survival equipment must be performed in accordance with the manufacturer's procedures or U.S./NATO applicable technical orders. No "on condition" determinations on rocket charges, propellants and initiators are acceptable. Include specific inspections and record keeping for pyrotechnic devices (explosives and propellants). If such maintenance documentations and requirements are not available, the seat must be de-activated. Notes: There are many NATO countries that operate the L-39 including the Czech Republic, Hungary, Slovakia, Lithuania, Estonia, and Bulgaria. There are companies that specialize in such tasks, both in the U.S. and overseas, notably the United Kingdom (U.K) and Canada. If ejection seats are not activated or armed at the time of airworthiness certification, the limitations should still be issued as to preclude re-activation without those requirements or the operating limitations should prohibit their re-activation or arming. Such a limitation could read: "This aircraft is not authorized to operate with live ejection seats." Ejection seat maintenance must be addressed in the AIP.	
125.	VS-1 Ejection Seat System Maintainers Training	Require adequate ejection seat training for maintenance crews. There is evidence that many operators and even companies that "specialize" in L-39 ejection seats are not maintaining the ejection seats adequately. Some of the issues are: (1) expired pyrotechnics devices (explosives and propellants), (2) wrong break-away wires, (3) poor recordkeeping, and (4) wrong settings on timers. This training should be addressed in the AIP and related procedures. In May 9, 2012, an improperly trained mechanic accidentally jettisoned the canopy of a jet warbird while performing maintenance, seriously injuring himself.	
126.	VS-1-BRI Ejection Seat System Safety on the Ground	Verify the safety of the ejection seats on the ground. Verify the ejection seats cannot be accidentally fired, including prohibitions of untrained personnel from sitting on the seats during maintenance, servicing, airshows, or other exhibition of the aircraft. Note: As a result of accidents, Department of Defense policy prohibits the public from sitting on armed ejection seats.	
127.	Ejection Seat Safety Pins	PIC/crew must carry the aircraft's escape systems safety pins on all flights and high-speed taxi tests. This stems from a fatal L-39 accident in the U.K.	
128.	Weight Adjustment of the VS-1-BRI Ejection Seat System	If an ejection seat is active, procedures must verify that at every flight, the weight of any occupant is properly adjusted in the ejection seat's system. Note: There is a limit in weight for the seat.	
129.	Parachutes	Comply with § 91.307 *Parachutes and Parachuting.* This regulation includes parachute requirements that include (1) the requirement for the parachute be of an approved type and packed by a certificated and appropriately rated parachute rigger and (2), if of a military type, that it be identified by an NAF, AAF, or AN drawing number, an AAF order number, or any other military designation or specification	

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		number.	
130.	External Stores	Do not install external stores to the wing that were not approved by the manufacturer or the operator (i.e., Czech Air Force, NATO operator). Additionally, there should be no means, mechanically or otherwise, of jettisoning the drops tanks while on the ground or in flight. The stores should be mechanically and permanently attached, and there should not be any cockpit control that would release them – no electric or cable connection. Note: In FAA Order 8130.2G, only aircraft certificated for the purpose of R&D may be eligible to operate with functional jettisonable external fuel tanks or stores.	
131.	Elimination of the Wing Tip Fuel Tanks	Verify that adequate engineering data exists for all modifications. Some L-39 restorers/service providers modify L-39s by removing the wing tip fuel tanks and replacing the tip with streamlined tips and engineering data may not be available. Note: The original wing tip fuel tanks are part of the original wing design.	
132.	Demilitarization	Verify that the aircraft has been adequately demilitarized. A weapon, a weapon system and related equipment can create safety of flight hazards under the jurisdiction of the FAA and must be removed. Safety issues with these systems include accidental firing, compartment fires, inadvertent discharge of flares, toxic chaff, electrical overloads of the aircraft electric system, danger of inadvertent release, structural damage to the aircraft, complex flight limitations, and harmful emissions. Although the basic L-39C is a training aircraft, other versions can be effective combat aircraft. For example, a common armed L-39 version, the L-39ZA, was designed for armed training and light attack. It has a sturdier landing gear, a higher payload (total 2,844 lb), and provisions for a GSh-23L 23 millimeter twin barreled cannon and K-13 or R-60 air-to-air missiles. In this case, removal of the cannon alone does not suffice. Wiring, switches, pylons (on some L-39 versions, i.e., ZO and ZA), and other sub-systems, to include parts of the armament panel, need to be disabled as well. In the case of the L-39, there is manufacturer guidance to demilitarize the aircraft, a *1992 Aero Vodochody Service Bulletin*. Additional guidance, such as *Verification of Demilitarization L-39,* is also available. Note: As discussed above, applicants should be aware of other applicable Federal requirements (i.e., ATF, Customs, DHS) affecting any equipment on the aircraft.	
133.	Mach Meter & Airspeed Calibration	Require the installation and calibration of a Mach meter or verify that the PIC makes the proper Mach determination before flight. Unless the airspeed indicator(s) is properly calibrated, transonic range operations may have to be restricted.	
134.	High-Speed Controllability	Limit transonic operations to a V_{ne} of Mach 0.7. This provides a good safety margin and could be addressed in the operating limitations, the Aircraft Flight Manual (AFM), and related SOPs.	
135.	Phase I Flight Testing	The aircraft needs detailed Phase I flight testing, totaling a minimum of 10 hours. Recommend that, at a minimum, all flight tests and flight test protocol(s) follows the intent and scope of acceptable USAF	

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		functionality test procedures (See below). Returning a high-performance aircraft such as the L-39 to flight status after restoration cannot be accomplished by a few hours of "flying around." Safe operations also require a demonstrated level of reliability.	
136.	Post-Maintenance Check Flights	Recommend that post maintenance flight checks be incorporated in the maintenance and operation of the aircraft and that T.O. 1-1-300, *Maintenance Operational Checks and Flight Checks,* June 15, 2012 be used as a reference.	
137.	Flight Over Populated Areas	Prohibit flights over populated areas, including take-offs and landings, if the ejection seat is functional. If not, the aircraft may be operated over populated areas for the purpose of takeoff and landing only, and only in Phase II operations. The area on the surface described by the term "only for the purpose of takeoff and landing" is the traffic pattern. For the purpose of this limitation, the term "only for the purpose of takeoff and landing," does not allow multiple traffic patterns for operations such as training or maintenance checks. No acrobatic flights over populated areas.	
138.	VMC and (IMC) Operations	Recommend day VMC (Visual Meteorological Condition) operations only. If IFR operations are permitted, prohibit known IMC (Instrument Metrological Conditions) conditions – aircraft is not properly equipped for icing conditions. Comply with 14 CFR § 91.205.	
139.	Carrying of Passengers §91. 319(a)(2)	The carrying of passengers for compensation (and property) for hire is prohibited at all times. For hire flight training is permitted only in accordance with an FAA issued letter of deviation authority (LODA). FAA LODA policy limits training to pilots eligible for L-39 experimental aircraft authorization. Note: The May 18, 2012 fatal L-39 accident was one of many flights where "rides" were being offered to "a group of eight people had paid for [the] flight package."	
140.	Low Altitude Maneuvering	Recommend that outside approved air show demonstrations, acrobatics, especially all vertical maneuvers, be limited to altitudes above 5,000 feet. Too many L-39 accidents have occurred because of aggressive low altitude maneuvering.	
141.	Reduce Vertical Separation Minimums (RVSM)	Operations prohibited above RVSM altitudes (FL290). Note: L-39 owners report that the L-39 optimum altitude is about FL270 clean.	
142.	High-Altitude Training	Recommended that the PIC complete an FAA-approved physiological training course (i.e., altitude chamber). See FAA Civil Aerospace Medical Institute (CAMI) Physiology & Survival Training Web site for additional information.	
143.	Minimum Equipment for Flight	Ask applicant to identify minimum equipment for flight. The applicant should develop a list consistent with the applicable military guidance (NATO is applicable) and § 91.213.	

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144.	Minimum Runway Length	The PIC must verify, using the appropriate aircraft performance charts (i.e., the RSAF "-1-1" Performance Supplement) that sufficient runway length is available with consideration given to field elevation and atmospheric conditions. To add a margin of safety, the following should be used: For Take-Off ➢ No person may take off that airplane unless it is possible— To stop the airplane safely on the runway, as shown by the accelerate-stop distance data To clear all obstacles either by at least 50 feet vertically (as shown by the takeoff path data) or 200 feet horizontally within the airport boundaries and 300 feet horizontally beyond the boundaries, without banking before reaching a height of 50 feet (as shown by the takeoff path data) and after that without banking more than 15 degrees. ➢ In applying this section, corrections must be made for any runway gradient. To allow for wind effect, takeoff data based on still air may be corrected by taking into account not more than 50 percent of any reported headwind component and not less than 150 percent of any reported tailwind component. For Landing ➢ No person may off that unless its weight on arrival, allowing for normal consumption of fuel and oil in flight (in accordance with the landing distance in the Airplane Flight Manual for the elevation of the destination airport and the wind conditions expected there at the time of landing), would allow a full stop landing at the intended destination airport within 60 percent of the effective length of each runway described below from a point 50 feet above the intersection of the obstruction clearance plane and the runway. For the purpose of determining the allowable landing weight at the destination airport, the following is assumed: o The airplane is landed on the most favorable runway and in the most favorable direction, in still air. o The airplane is landed on the most suitable runway considering the probable wind velocity and direction and the ground handling characteristics of that airplane, and considering other conditions such as landing aids and terrain.	
145.	Runway Safety Areas (RSA)	Recommend the appropriate runway safety areas (RSA) to add a margin of safety. A RSA enhance safety in the event of an undershoot (landing short), overrun, or excursion from the side of the runway. The RSA standard is part of FAA's airport design standards. See FAA Advisory Circular (AC) 150/5300-13, *Airport Design*) and consider Engineered Materials arresting Systems (EMAS). For guidance on EMAS, see AC	

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		150/5220-22 *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns*	
146.	Runway Considerations	Consider accelerate/stop distances, balanced field length, and critical field length in determining acceptable runway use per CJAA (Classic Jet Aircraft Association) guidance. To enhance L-39 operations, it is recommended that take-off procedures similar to the USAF's minimum acceleration check speed (using a ground reference during the take–off run to check for a pre-calculated speed) be adopted. For landing, procedures similar to those described in § 91.1037 to allow a full stop landing within 80 percent of the effective length of each runway, should also be used.	
147.	Jet Exhaust Dangers	Establish adequate jet blast safety procedures in terms of air blast, heat and noise. The CJAA Jet Manual be used as reference.	
148.	Servicing	The applicant should verify that ground personnel are trained for L-39 operations. They should be aware of the potential for fires during servicing and emergency procedures (i.e., fire guard duty, rescue, emergency shut-down).	
149.	Nose Gear Damage During Towing	The operator should adhere to the manufacturer's towing procedures. The L-39 nose landing gear was designed only to accept the vertical force which is created by the weight of the aircraft's nose at touch down. Note: An accident investigation noted that the "NLG micro switch plunger had been bent, possibly when the aircraft was towed from the hangar."	
150.	External Tank Failure	Restrict external tanks to only those cleared by the manufacturer. Adhere to the drop tank limitations related to (1) take-off and landing performance, (2) G limits, (3) airspeed, and (4) fuel in the tanks.	
151.	ARFF Coordination	Coordinate with Aircraft Rescue and Fire Fighting (ARFF) personnel at any airport of landing (i.e., safety briefing, fuel system, ejection seat system, emergency shut-down).	
152.	ATC Coordination	Coordinate with Air Traffic Control (ATC) prior to any operation that may interfere with normal flow of traffic and to avoid flight over populated areas.	
153.	Personal Flight Equipment	Recommend that operator use the adequate personal flight equipment and attire to verify safe operations. This includes: helmet, oxygen mask, fire retardant (Nomex) flight suit, gloves (i.e., Nomex or leather), adequate foot gear (i.e., boots) and clothing that does not interfere with cockpit systems and flight controls. Operating with a live ejection seat requires a harness. Therefore, recommend that only an approved harness compatible with the ejection seat be used.	
154.	Military Contract Operations	Many L-39 operators have entered into contracts with DOD to provide military missions such as air combat maneuvering (ACM), target towing and, electronic counter measures (ECM). Such operations constitute "public aircraft operations" (PAO), not civil operations under FAA jurisdiction. The operator is required to obtain a declaration of PAO from the contracting entity or risk civil penalty for operating the aircraft	

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		outside the limits of the FAA experimental certificate. Verify the operator understands PAO vs. operations under a civil certificate. For example, the purpose of an airworthiness certificate in the exhibition category is limited to activities listed in §21.191(d). Note: The following notice, which was issued by AFS-1 in March 2012, needs to be communicated to the applicant: "Any pilot operating a U.S. civil aircraft with an experimental certificate while conducting operations such as air-to-air combat simulations, electronic counter measures, target towing for aerial gunnery, and/or dropping simulated ordinances is operating *contrary* to the limits of the experimental certificate. Any operator offering to use a U.S. civil aircraft with an experimental certificate to conduct operations such as air-to-air combat simulations, electronic counter measures, target towing for aerial gunnery, and/or dropping simulated ordinances pursuant to a contract or other agreement with a foreign government or other foreign entity would not be doing so in accordance with any authority granted by the FAA as the State of Registry or State of the Operator. These activities are not included in the list of experimental certificate approved operations and may be subject to enforcement action by FAA. For those experimental aircraft operating overseas *within* the limitations of their certificate, FAA Order 8130.2G, section 7, paragraph 4071 (b) states "If an experimental airworthiness certificate is issued to an aircraft located in or outside of the United States for time-limited operations in another country, the experimental airworthiness certificate must be accompanied by appropriate operating limitations that have been coordinated with the responsible [civil aviation authority] CAA *before* issuance." For additional information on public aircraft status, see 76 FR 16349, *Notice of Policy Regarding Civil Aircraft Operators Providing Contract Support to Government Entities (Public Aircraft Operations)*, dated March 23, 2011.	
155.	TO 00-80G-1 and Display Safety	Recommend the use of Technical Order TO 00-80G-1 *Make Safe Procedures for Public Static Display,* Technical Order TO 00-80G-1, dated November 30, 2002, in preparing for displaying of the aircraft. This document addresses public safety around aircraft in the Airshow/display environment. It covers hydraulics, egress systems, fuel, arresting hooks, electrical, emergency power, pneumatic, air or ground launched missiles, weapons release (including inert rounds), access panels, antennae, and other and other equipment that can create a hazard peculiar to certain aircraft.	
L-39 Aircraft Flight Manual (AFM), SOPs, and Best Practices			
156.	AFM Addendums	Consider additions or restrictions to the AFM to reflect safety issues discussed in this document.	
157.	Annual Recurrent Training	Recommend that L-39 operators conduct annual recurrent training, both ground and flight training. There are organizations that specialize in such training. (See below). This adds a level of safety to L-39 operations, especially in light of the fact that many L-39 accidents are pilot related. Note: There are indications that	

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		insurance companies that ensure L-39 operators are or will require such training in the near future because "due to the high incident/accident rate within the L-39 community."	
158.	L-39 Training/Conversion Courses	Recommend that the applicant/operator receives L-39 training through a comprehensive training course and by experience provider. Such courses, comprised of ground and flight training, would typically cover: L-39 History, Fight Manual Definitions and Overview, Aircraft Manual Protocols and Conventions, Cockpit Orientation, Aircraft Instrumentation, Controls and Indicators, Engine Operation and Limitations, Aircraft Systems Operation and Limitations, Normal Procedures and Flight Characteristics, Irregular/Abnormal Procedures, Emergency Procedures and Immediate Action Items, Oxygen and Pressurization Systems, Ground Egress, Bailout, Ejection and Parachute Operations, Auxiliary Equipment, All-Weather Operations, Pilot Techniques and Cockpit Organization, Flight Physiology and G-Straining Maneuver, High Altitude Aerodynamics, Flight Planning and Takeoff/Landing Performance, Weight and Balance, Pre-Flight Inspection, Hands-On Aircraft Servicing and Owner-Performed Maintenance, Flight Safety Awareness, and Situational Awareness.	
159.	Low Altitude Maneuvering	Recommend that the applicant/operator consider operational restrictions (i.e., SOPs on minimum altitude, Gs and type of maneuvers) at low altitude maneuvering, including Air Show demonstrations. The reason for this is that L-39 demonstrations at low altitude have a significant accident history.	
160.	In-Flight Canopy Separation	Revise the pilot checklist and back-seat occupant briefing to emphasize (i.e., "warning – caution") the proper closing of the canopy. The NTSB noted that the in-flight failure and separation of the canopy was a contributing factor to an accident."	
161.	AI-25 Maximum Continuous Power	Adhere to all maximum continuous engine power time limits.	
162.	Use of Aft Cockpit, Failure Simulation Features and Switches	AFM should provide for procedures to verify the safe operation of all back seat functions that allow the pilot in the back seat to simulate the failure of systems in the front seat. Due to their design for use in dual instruction, L-39s may be equipped with switches and functions in the back seat allowing an instructor to disable some instruments in the front cockpit to simulate failures.	
163.	Brake & Steering System	Verify that an adequate check-out on the aircraft's brake and steering system has been given to anyone taking control of the aircraft on the ground. The L-39 is fitted with an unusual hand brake system and a combination of this and differential braking is required. It is not easy to master and poses safety issues.	
164.	Emergency Wheel Brakes Training	As a result of an accident, the U.K. CAA recommends that "L-39 Albatros operators include the use of the Emergency wheel brakes into the training syllabus and normal operation of the aircraft type."	

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165.	Touch Down and Deceleration Technique	In conjunction with the applicable AFM, and any specifics on the aircraft, recommend the establishments of procedures for correct touch down and deceleration procedures and thorough familiarization with related systems and their proper use, including proper sequencing of actions and variables. These include: proper speed on final and at touchdown, wind conditions, nose down or up, flaps up or down, brake application, and anti-skid engagement. Despite the aircraft's benign appearance, there have been several serious L-39 overrun incidents and accidents. As an experienced L-39 pilot notes "first and foremost, *know your systems*! Running down the runway at 100 KIAS is not the time to start asking questions." Note: Tail strikes have been reported in L-39 landings due to an overly aggressive holding back of the nose to affect better aerodynamic braking and reduce wear on the brakes.	
166.	FAA Advisory Circular AC 91-79	Recommend the use of FAA Advisory Circular (AC 91-79). According to AC 91-79, safe landings begin long before touchdown. Adhering to standard operating procedures and best practices for stabilized approaches will always be the first line of defense in preventing a runway overrun.	
167.	Forward Cargo/Storage Area Opening in Flight	Include "Remove Before Flight" banner/flag in forward storage compartment. An L-39 was lost when during the take-off run, the nose compartment opened and its content were ingested into the engine. Recommend SOPs to address this. Note: A previous accident in the U.S. was fatal. Note: Some L-39s have a custom "nose baggage compartment."	
168.	Automatic Flap Speed Sensor	Recommend SOPs to address un-commanded flap movements especially during take-off and in the landing configuration. This may be mitigated in pre-flight by properly inspecting the flaps by hand, i.e., check for the lack of movement of the flaps on the ground.	
169.	Inadvertent Switch Off of the Seat Blocking Emergency Source	The inadvertent switching off of the seat blocking emergency source can disconnect the 3Kw Ram Air Turbine (RAT). Emphasize this concern in the AFM and recommend SOPs to address this risk.	
170.	Minimum Fuel and Specific Range	To add a safety margin, and in addition to § 91.151 *Fuel requirements for Flight in VFR Conditions*, recommend the establishments of SOPs addressing minimum landing fuel for IFR operations as provided in § 91.167. In addition, a "Bingo" fuel status (a pre-briefed amount of fuel for an aircraft that would allow a safe return to the base of intended landing, i.e., 500 lbs.) should be used in all flights. Note: Bingo fuel and minimum landing fuel are not necessarily the same in that a call for Bingo fuel and a RTB still required managing the minimum landing fuel. Recommend SOPs addressing actual aircraft specific range (nautical air miles traveled per pound of fuel used). For example, it might be important of verifying performance adapt like "cruise at 23,000 feet, 345Kts, 152GPH, 99% resulting in 2.27MPG." Similarly, a range limit could be used (planned fuel stops), such as 450 nautical miles at a cruise altitude of 16 to 26,000 feet with 200 gallons available.	

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171.	Manufacturer's Trouble Shooting Card	Recommend the use of the *Trouble Shooting Card* found in *Aero Bulletin for Users of L-30 Jet Training Aircraft,* Aero Vodochody, 1/1983. This document can assist in reporting and mitigating operational malfunctions.	
172.	L-39 MTBF and Availability	Recommend that the applicant/operator review and familiarize themselves with the Czech Air Force L-39 MTBF and Availability data provided in *Evolution of Aircraft Maintenance/Support Concepts with Particular Reference to Aircraft Availability – Czech Air Force Perspective*, NATO report RTO-MP-AVT-144. This is important because it provides data such as numbers of hours, failures, failures in flight, and MTBF rates for the years 1974-1998.	
173.	Type Clubs or Organizations	Recommend that the applicant/operator join a L-39 type club or organization. This facilitates safety information collection and dissemination.	
174.	FAA Advisory Circular AC 91-79	Recommend the use of FAA Advisory Circular AC 91-79, *Runway Overrun Prevention*. According to AC 91-79, safe landings begin long before touchdown. Adhering to standard operating procedures and best practices for stabilized approaches will always be the first line of defense in preventing a runway overrun.	
175.	Reporting Malfunctions and Defects	Ask applicant/operator to report malfunctions and equipment defects found in maintenance, pre-flight, flight and post-flight inspection. This would yield significantly safety benefits to both operators and the FAA.	

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Additional Resources

- Aero Vodochody a.s. (OEM) resources (http://www.aero.cz)
- L-39 accident reports issued by the NTSB in the U.S. or other foreign investigative agencies (i.e., AAIB in the U.K.)
- *L-39 Demilitarization Memo,* Aero Vodochody, 1992.
- L-39 forums in *L-39 Enthusiast* at http://www.l39.com.
- L-39 *Technical Letters* at http://www.l39.com/content/newsletter-archive. These *Technical Letters* cover and discuss many issues with the aircraft including:
  - Turbine Failure and Engine Oil Check
  - Replacement Canopies
  - Zero Flap Takeoff Profile
  - Simulated Engine Failure Landing
  - Fuel Calculation
  - Bleed Air Explosion
  - AI-25TLSh Engine Description
  - G Suits, Brake Problems
  - Compressor Issues and Air Pressure Problems
  - Elevator Bearing Maintenance
  - Fuel, Rudder Balancing, Limited Life Items
- Australia's CAAP 30-3(0), *Approved Maintenance Organization (AMO) — Limited Category Aircraft,* Civil Aviation Advisory Publication, December 2001. This publication addresses the restoration and maintenance of ex-military aircraft and is an excellent guide for developing adequate aircraft maintenance and inspection programs.
- *Aviation Safety,* AFSP-1(A), NATO, March 2007.
- *CHAPTER 10 Naval Aviation Maintenance Program Standard Operating Procedures* (NAMPSOPs).
- *CJAA SAFETY OPERATIONS MANUAL*, Rev. 6/30/08.
- *Aircraft Refueling NATOPS Manual*, NAVAIR 00-80T-109, June 15, 2002.
- CAP 632, *Operation of Permit to Fly Ex-Military Aircraft on the UK Register.* This is a comprehensive source of information and guidance on topics like technical requirements, specialist equipment and systems, pilot/crew qualification, operational requirements, records and oversight procedure, and safety management.
- *Maintenance and Manufacturing Staff Instructions, MSI 52, Issuance of Special Certificate of Airworthiness – Limited.* Transport Canada, March 31, 2006.
- NZ CAA AC 43-21 *Escape and Egress Systems*, 25, December 1997.
- FAA News magazine (November/December 2003) article by H. Dean Chamberlain entitled *Armed and Dangerous.*
- *Ejection Systems and the Human Factors: A Guide for Flight Surgeons and Aeromedical Trainers,* Defense and Civil Institute of Environmental Medicine, DND, Canada, May 1988.
- NATOPS *General Flight and Operating Instructions*, OPNAVINST 3710.7U, November 23, 2009.
- *Guidance for the EPA Halon Emission Reduction Rule* (40 CFR part 82, subpart H).
- FAA AC 150/5300-13, *Airport Design*.

- AC 150/5220-22 Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns and AC 5220-9A *Aircraft Arresting Systems*.
- NATOPS *U.S. Navy Aircraft Firefighting and Rescue Manual,* NAVAIR 00-80R-14, 10/15/2003.
- TO 1-1-691, *Corrosion Prevention and Control Manual.*
- Department of Defense MANUAL 4160.28 (Volume 3) June 7, 2011 *Defense Demilitarization: Procedural Guidance.*
- *Evolution of Aircraft Maintenance/Support Concepts with Particular Reference to Aircraft Availability – Czech Air Force Perspective*, NATO report RTO-MP-AVT-144. This paper describes the Czech Air Force approach and experience gained during development of the Czech Subsonic Advanced Light Combat Aircraft L-159 from the point of view of maintenance concept and logistic support in general and experience gained from the L-39.
- *Human Factors Good Practices in Borescope Inspection* by Colin G. Drury and Jean Watson (FAA), May 2001.
- EAA Warbirds of America article entitled *Warbird Airmanship*, by Greg Morris, Warbirds (magazine), (March 2009).
- USAF AFP 127-1 and NAVAIR 00-80T-116-2 *Technical Manual Safety Investigation, Volume II Investigative Techniques,* July 31, 1987.
- TO 1-1A-1 *Engineering Handbook Series for Aircraft Repair, General Manual for Structural Repair*, November 15, 2006.
- T.O. 1-1-300, *Maintenance Operational Checks and Flight Checks,* June 15, 2012.
- *Aerodynamics for Naval Aviators.* NAVPERS 00-8-T-80, Revised January 1965.
- COMNAVAIRFORINST 4790.2A, *CHAPTER 16 Intermediate Level (I-Level) Maintenance Data System (MDS) Functions, Responsibilities, and Source Document Procedures*, CH-2 10 Nov 2009.
- *Civil Air Displays: A Guide for Pilots.* CAA Document No. 743, Safety Regulation Group, Civil Aviation Authority (UK), 2003.
- *Brake Dancing, or How to Stop an L-39: L-39 Wheel Brake System.* Article Richard Hess.

Recommendations for Review of Prior Actions

- As provided by § 14 CFR 91.415, review the submitted maintenance manual(s) and aircraft inspection program and work with the applicant to revise the aircraft inspection program (AIP) as needed based on any concerns identified in Attachment (2). For example, a L-39 AIP can be modified to verify:
  - Consistency with the applicable airframe, powerplant, and systems military technical orders, to verify that replacement/interval times are covered.
  - All AIP section and sub-sections include the proper guidance/standards (i.e. Technical Orders or Engineering Orders) for all systems, groups, and tasks.
  - No “on condition” for items that have fixed replacement times unless justified with appropriate substantiating data; i.e., aileron boost and oxygen regulator.
  - Ejection seat system replacement times. No “on condition” for rocket motors and propellants. Make the distinction between replacement times, “shelf life” v. “installed life limit.” For example, a 9 year replacement in the AIP does not address a 2 year installed limit.
  - Any deferred log is related to a listing of minimum equipment for flight.
  - Inclusion of document revision page(s).

- Verify that the application for airworthiness does not constitute brokering. Section 21.191(d) was not intended to allow for the brokering or marketing of experimental aircraft. This includes individuals who manufacture, import, or assemble aircraft, and then apply for and receive experimental exhibition airworthiness certificates so they can sell the aircraft to buyers. Section 21.191(d) only provides for the exhibition of an aircraft's flight capabilities, performance, or unusual characteristics at airshows, and for motion picture, television, and similar productions. Certificating offices must verify that all applications for exhibition airworthiness certificates are for the purposes specified under § 21.191(d), and are from the registered owners who will exhibit the aircraft for those purposes. Applicants must also provide the applicable information specified in § 21.193.
- Review any related documents from U.S. Customs and Border Protection and the Bureau of Alcohol, Tobacco and Firearms (ATF) for the aircraft. If the aircraft was not imported as an aircraft, or if the aircraft configuration is not as stated in Form ATF-6, it may not be eligible for an airworthiness certificate.

Aero Vodochody L-39 Accidents (1998-2012) in the U.S.

1.	09/01/2012	Davenport, IA	Aero Vodochody L-39	N139GS	Fatal(1)	LOC (Possible)
2.	5/18/2012	Boulder City, NV	Aero Vodochody L-39	N39WT	Fatal(2)	Unknown
3.	03/23/2012	Punta Gorda, FL	Aero Vodochody L-39	N138EM	Nonfatal	Unknown
4.	1/20/2012	Rainbow City, AL	Aero Vodochody L-39	N16RZ	Fatal(1)	After Take-Off Accident
5.	7/9/2011	West Milford, NJ	Aero Vodochody L-39	N111XN	Nonfatal	Overrun
6.	11/24/2009	Carson City, NV	Aero Vodochody L-39C	NX711LC	Nonfatal	Gear-Up Landing (No Mains)
7.	04/03/2009	Houma, LA	Aero Vodochody L-39	Unknown	Nonfatal	Tire Burst/Excursion
8.	9/13/2007	Reno, NV	Aero Vodochody L-39C	N139DK	Fatal(1)	LOC
9.	3/16/2007	Titusville, FL	Aero Vodochody L-39C	N63925	Fatal(1)	LOC (Low Altitude)
10.	2/26/2006	California City, CA	Aero Vodochody L-39	N39DF	Fatal(2)	LOC (Low Altitude)
11.	02/06/2006	Millville, NJ	Aero Vodochody L-39	N129DH	Nonfatal	Canopy Separation
12.	1/25/2006	Ketchikan, AK	Aero Vodochody L-39MS	N104XX	Fatal(1)	LOC on Landing
13.	10/26/2005	Fort Myers, FL	Aero Vodochody L-39	N989BH	Nonfatal	Excursion - Brakes
14.	09/22/2005	Suffolk, VA	Aero Vodochody L-39	N614RM	Nonfatal	Overrun - Brakes
15.	03/07/2005	Shreveport, LA	Aero Vodochody L-39C	N8098T	Nonfatal	Overrun
16.	10/19/2004	Hyak, WA	Aero Vodochody L-39C	N39TJ	Fatal(2)	Unknown
17.	06/13/2004	Griffiths, NY	Aero Vodochody L-39C	N3083Y,	Nonfatal	Landing Gear Failure
18.	10/13/2003	Lexington, KY	Aero Vodochody L-39ZO	N139RG	Nonfatal	Tire Burst/Excursion
19.	8/24/2003	Forest Hill, MD	Aero Vodochody L-39ZO	N298RD	Fatal(1)	LOC on Landing
20.	6/30/2003	Gadsden, AL	Aero Vodochody L-39C	N8125R	Fatal(1)	Engine FOD/LOC
21.	5/30/2003	Tracy, CA	Aero Vodochody L-39	N139RH	Fatal(1)	LOC (Maneuvering)
22.	10/30/2001	Wilmington, DE	Aero Vodochody L-39C	N90688	Nonfatal	Fire - Oil System
23.	2/10/2001	Pecan Island, LA	Aero Vodochody L-39C	N901NL	Fatal(2)	LOC (Maneuvering)
24.	1/24/2001	Watkins, CO	Aero Vodochody L-39CT	N602MC	Fatal(2)	LOC – CG - Canopy
25.	12/16/2000	Hilton Head, SC	Aero Vodochody L-39C	N139CG	Nonfatal	Gear-Up
26.	9/18/1998	Mesa, AZ	Aero Vodochody L-39	N44529	Nonfatal	LOC on Landing
27.	7/3/1998	Traverse City, MI	Aero Vodochody L-39C	N7868M	Fatal(2)	Lost Over Lake Michigan

(Note: Events in Red are classified as serious incidents)

Aero Vodochody L-39 Foreign Civil Accidents

28.	September 15, 2012	Netherlands	----------	Non-Fatal	ES-YLS	Engine Failure
29.	June 30, 2012	South Africa	Aero Vodochody L-39	ZU-HIT	Fatal (1)	LOC (Low Altitude)
30.	June 30, 2012	South Africa	Aero Vodochody L-39	ZU-HIT	Fatal (1)	LOC (Low Altitude)
31.	April 20, 2012	France	Aero Vodochody L-39	RA-3514K	Nonfatal	Engine Failure
32.	March 21, 1010	Venezuela	Aero Vodochody L-39	VY100X	Fatal (10)	Loss of Power on Final
33.	December 10, 2004	England	Aero Vodochody L-39	G-OLAB	Nonfatal	In-Flight Canopy Separation
34.	August 2, 2003	England	Aero Vodochody L-39	G-OTAF	Nonfatal	Engine Failure
35.	Jun 2, 2002	England	Aero Vodochody L-39	G-BZVL	Fatal (1)	Brake System and Operation of

Aero Vodochody L-39 Foreign Military Accidents

36.	September 22, 2012	Ukrainian Air Force	_____	Fatal (1)	Possible Engine Failure
37.	Apr 5, 2012	Bangladesh Air Force	----------	Fatal (1)	Engine Failure
38.	Oct 28, 2011	Nigeria Air Force	----------	Non-Fatal	Ejections - Unknown
39.	Aug 30, 2011	Lithuanian Air Force	----------	Non-Fatal	Ejection - Mid-Air

40.	Aug 30, 2011	Lithuanian Air Force	----------	Non-fatal	Mid-Air
41.	Dec 16, 2010	Czech Air Force	----------	Non-Fatal	Ejection - Engine Failure
42.	Jul 12, 2010	Czech Air Force	----------	Non-Fatal	Ejection - Engine Failure
43.	Jan 13, 2010	Yemen Air Force	----------	Fatal(1)	Loss of Control (Mechanical)
44.	Mar 17, 2009	Russian Air Force	----------	Fatal	LOC
45.	Feb 23, 2009	Algerian Air Force	----------	Fatal(2)	CFIT
46.	Mar 17, 2009	Russian Air Force	----------	Fatal(2)	Unknown
47.	Feb 23, 2009	Algerian Air Force	----------	Fatal(1)	Unknown
48.	Jun 20, 2008	Hungarian Air Force	----------	Fatal (2)	Failed Ejection - Unknown
49.	April 2008	Cuban Air Force	----------	Fatal (1)	Engine Fire - 1 Crew Killed
50.	Feb 1, 2008	Russian Air Force	----------	Non-Fatal	Engine Failure
51.	Jan 28, 2008	Russian Air Force	----------	Fatal (1)	1 Crew Killed During Ejection
52.	Aug 7, 2007	Russian Air Force	----------	Non-Fatal	Ejections, Engine Failure
53.	Jun 5, 2007	VPAF	----------	Fatal (2)	No Ejections – Tech. Fault
54.	Sep 14, 2007	Russian Air Force	----------	Fatal (1)	Training Flight - Unknown
55.	2007	Ethiopian AF	----------	Non-Fatal	Engine Failure
56.	Sep 9, 2006	Russian Air Force	----------	Fatal (1)	1 Successful Ejection, Unknown
57.	Jun 26, 2006	Belarus Air Force	----------	Non-Fatal	Landing Gear Failure
58.	Jun 6, 2006	Thai Air Force	----------	Non-Fatal	Hard Landing
59.	Sep 20, 2005	Russian Air Force	----------	Non-Fatal	Engine Failure
60.	Apr 9, 2005	VPAF	----------	Fatal (1)	1 Ejection- Engine Failure
61.	Sep x, 2004	Russian Air Force	----------	Non-Fatal	Unknown
62.	Jan 24, 2004	Nigerian Air Force	----------	Unknown	Unknown
63.	Jan 22, 2004	Ukrainian Air Force	----------	Non-Fatal	L-39C, Ejections, Engine Failure
64.	Jul 14, 2003	Russian Air Force	----------	Fatal (2)	Engine Failure - LOC
65.	Apr 2, 2003	Yemen Air Force	----------	Fatal (2)	L-39C, Unknown
66.	Feb 24, 2003	Czech Air Force	----------	Fatal (1)	Unknown
67.	Jan 13, 2003	Yemen AF	----------	Nonfatal	Mechanical Failure
68.	Oct 29, 2002	Slovakian Air Force	----------	Non-Fatal	Ejections - Unknown
69.	Sep 16, 2002	Algerian Air Force	----------	Unknown	Unknown
70.	Aug 12, 2002	Russian Air Force	----------	Fatal	Unknown
71.	Jun 14, 2002	Russian Air Force	----------	Non-Fatal	Ejections - Unknown
72.	Apr 12, 2002	Russian Air Force	----------	Non-Fatal	Ejections - Engine Failure
73.	February 24, 2002	Czech Air Force	----------	Fatal	Unknown (L-159)
74.	Oct 10, 2001	Thai Air Force	----------	Fatal(1)	Engine Failure
75.	Aug 1, 2001	Czech Air Force	----------	Fatal (1)	Low Altitude Acrobatics
76.	Jul 11, 2001	Russian Air Force	----------	Fatal (2)	Mechanical Failure After Take-Off
77.	Jun 10, 2001	Russian Air Force	----------	Fatal (1)	Mid-Air
78.	Jun 10, 2001	Russian Air Force	----------	Non-Fatal	Mid-Air
79.	Apr 19, 2001	Russian Air Force	----------	Non-Fatal	Engine Fire
80.	Nov 10, 2000	Thai Air Force	----------	Fatal (1)	1 Successful Ejection
81.	Sep 14, 2000	Slovakia Air Force	----------	Non-Fatal	Engine Failure (Fuel System)
82.	Jul 20, 2000	Thai Air Force		Non-Fatal	2 Ejections - Unknown
83.	Jun 3, 2000	Slovakia Air Force	----------	Fatal (1)	Pilot Error - Low Alt. Aerobatics
84.	Jan 24, 2000	Thai Air Force	----------	Unknown	Unknown
85.	Sep 6, 1999	Tunisian Air Force	----------	Unknown	Unknown
86.	Jul 31, 1998	Tunisian Air Force	----------	Unknown	Unknown
87.	Feb 18, 1998	Czech Air Force	----------	Fatal (1)	Training Flight - LOC
88.	Dec 12, 1997	Cambodia Air Force	----------	Unknown	Pilot Error - Low Alt. Aerobatics
89.	Sep 16, 1997	Thai Air Force	----------	Fatal (1)	1 Successful Ejection - Engine Failure
90.	Aug 19, 1997	Tunisian Air Force	----------	Unknown	Unknown
91.	Jan 11, 1997	Romanian Air Force	----------	Fatal (2)	Pilot Error
92.	Sep 4, 1996	Thai Air Force	----------	Unknown	Unknown

93.	Aug 26, 1996	Ukrainian Air Force	----------	Unknown	Unknown
94.	Jul 17, 1996	Slovakia Air Force	----------	Non-Fatal	Ejections – Mid-Air
95.	Jul 17, 1996	Slovakia Air Force	----------	Non-Fatal	Ejections – Mid-Air
96.	Mar 5, 1996	Thai Air Force	----------	Unknown	Unknown
97.	Feb 3, 1996	Czech Air Force	----------	Non-Fatal l	Ejections, Unknown
98.	Feb 1, 1996	Czech Air Force	----------	Non-Fatal	Engine Fire, Ejections,
99.	Jul 25, 1995	Hungarian Air Force	----------	Non-Fatal	Ejections, Unknown
100.	1995	Tunisian Air Force	----------	Unknown	Unknown
101.	Dec 19, 1994	Chechen Air Force	----------	Unknown	Unknown
102.	Oct 4, 1994	Chechen Air Force	----------	Unknown	Unknown
103.	1994	Ethiopian AF	----------	Fatal (2)	Unknown
104.	Sep 21, 1993	Egyptian Air Force	----------	Unknown	Landing Accident
105.	Sept 11, 1992	Czech Air Force	----------	Unknown	Unknown
106.	Aug 28, 1991	Russian Air Force	----------	Non-Fatal	Ejection, Engine Failure
107.	Aug 22, 1991	Czech Air Force	----------	Fatal (2)	Failed Ejections – Engine Failure
108.	Apr 29, 1991	Russian Air Force	----------	Non-Fatal	Ejection, Engine Failure
109.	Apr 3, 1991	Czech Air Force	----------	Nonfatal	Engine Fire
110.	Oct 2, 1990	Bulgarian Air Force	----------	Fatal(2)	Unknown
111.	Oct 2, 1990	Czech Air Force	----------	Fatal (1)	Low Altitude Maneuvering
112.	Aug 2, 1990	Rumanian Air Force	----------	Fatal (2)	L-39AZ, Engine Failure
113.	Oct 2, 1990	Bulgaria Air Force	----------	Unknown	Unknown
114.	Sep 22, 1990	Czech Air Force	----------	Fatal (1)	Unknown – Low Altitude Ejection
115.	Aug 15, 1989	Czech Air Force	----------	Unknown	Mid-Air With Civil Aircraft
116.	Apr 11, 1989	Czech Air Force	----------	Nonfatal	Engine Failure (Blades)
117.	Aug 24, 1988	Czech Air Force	----------	Nonfatal	Engine Failure
118.	Aug 17, 1988	Czech Air Force	----------	Nonfatal	Engine Failure on Final
119.	May 30, 1980	Czech Air Force	----------	Unknown	Unknown